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Point de l'ordre du jour : D.14

Bulgarie

L'EDIFICATION DES STATIONS DE VILLEGIATURE EN LA REPUBLIQUE POPULAIRE DE BULGARIE

Par Todor TODOROV,
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L'EDIFICATION DES STATIONS DE VILLEGIATURE EN LA REPUBLIQUE POPULAIRE DE BULGARIE

par Todor TODOROV, architecte, chef de la Section des "Constructions culturelles et d'utilité publique" auprès du Comité d'Etat de construction et d'architecture

1 - La prophylaxie est l'essence même de l'organisation de la santé publique en Bulgarie. L'oeuvre des villégiatures forme une branche importante de la médecine prophylactique.

2 - Le repos des citoyens est un droit établi par la Constitution de la République populaire de Bulgarie. De pair avec les mesures prises pour la réduction de la journée de travail et pour l'octroi des congés payés annuels, le droit au repos est assuré par la création d'un vaste réseau de maisons de repos, de clubs etc. Le décret assurant l'assistance médicale gratuite pour le peuple tout entier (No.131 du 17 mars 1951) est une preuve incontestable des soins diligents de l'Etat en vue de préserver la santé du peuple. La sollicitude toute spéciale et le souci apportés à la solution d'ensemble, équitable et opportune des problèmes touchant au développement de l'édification des stations de villégiature sont devenus, par leur substance, une exigence constante et imprescriptible du peuple envers le pouvoir d'Etat de la RP de Bulgarie. Le peuple est profondement convaicu que la santé et l'aptitude au travail de la population constituent la base des succès enregistrés dans le développement matériel et culturel et que, par conséquent, ce sont des gages tangibles pour l'existence de la nation.

3 - Les excellentes conditions climatiques, les nombreuses et très diverses sources minérales, la mer chaude et ensoleillée avec ses agréables plages, l'air frais des montagnes couvertes de forêts séculaires, ainsi que l'abondance de succulents fruits et légumes cachent en soi d'inépuisables possibilités potentielles pour le développement le plus vaste de l'oeuvre de villégiature dans le pays.

4 - Réorganisé fondamentalement après la Seconde guerre mondiale, l'oeuvre de villégiature en Bulgarie a réussi à rompre avec les néfastes traditions du passé et tracé une voie toute nouvelle à l'exploitation et à l'utilisation équitable et culturelle des richesses naturelles du pays.

5 - On a entrepris des travaux systématiques et planifiés sur une vaste échelle en vue:

a/ de connaître et conserver les vertus curatives des facteurs de villégiature, en créant des méthodes scientifiquement fondées pour l'exploitation des stations de cure. Ces méthodes confirmaient, complétaient et corrigeaient les indications et les contre-indications élaborées empiriquement dans le passé.

b/ de procéder à de nouveaux captages modernes des sources minérales existantes, ainsi que de rechercher de nouvelles possibilités d'accroître le débit des eaux curatives et des gisements de boue médicinale.

c/ d'étudier les prémisses matérielles du développement des stations de villégiature.

d/ de faire un choix judicieux des points de départ pour les communications avec les différentes localités ou stations de villégiature.

6 - Presque toutes les stations de villégiature en Bulgarie offrent la possibilité d'un travail combiné - prophylactique et curatif. Toutefois, pour des raisons de spécificité des différents facteurs, nous avons adopté la classification déjà connue des objectifs: balnéaires, cure de boue, climatiques (de montagne ou maritimes) et mixtes. Par son essence cette classification est trop universelle et ne donne aucune indication pour le caractère, le volume ou la portée du travail curatif et des initiatives de construction.

7 - La planification urbaniste, ainsi que l'édification architecturale et des travaux publics en Bulgarie cherche à trouver des points de repère dans les fonctions et l'importance des stations de villégiature, dont la condition principale pour leur édification est l'effet curatif, surtout l'effet curatif pour les maladies spécifiques. A cet effet la pratique des constructions chez nous applique une autre classification:

a/ objectifs d'intérêt international, qui possèdentdes vertus curatives n'existant pas ou ne disposant que de possibilités de développement limitées dans les autres pays. L'idée qui préside à l'édification de ces stations est avant tout nos obligations sociales et internationales et, ensuite, notre droit de propriétaires.

b/ des stations de villégiature nationales, qui possèdent également d'excellentes vertus curatives et présentent, elles aussi, de l'intérêt pour le tourisme international, le repos et la cure. Le plus souvent leurs vertus curatives sont spécifiques pour le pays, mais dans le cadre international elles existent ailleurs aussi,dans différentes variantes. Ces objectifs s'améliorent avec le temps, acquièrent de la popularité et, dans certaines conditions, peuvent devenir facilement des stations de villégiature d'intérêt international. Voici pourquoi, avant de poser la tâche de leur édification aux architectes et aux constructeurs, nous analysons avec beaucoup d'attention tous les indices les concernant.

c/ stations de villégiature d'intérêt local. Ce sont des objectifs de caractère strictement prophylactique et jouent un grand rôle pour le repos hebdomadaire de la population.

8 - En Bulgarie l'administration locale et la population disposent de possibilités illimitées d'initiative et d'activité créatrice, ce qui leur permet d'apporter leur précieux concours dans l'édification des stations de villégiature. Il suffit que la population locale comprenne l'utilité publique d'une initiative, pour qu'elle apporte tout son concours de masse dans l'aménagement des agglomérations, surtout lorsqu'il s'agit de l'embellissement des stations de villégiature. Il arrive même, que les autorités et la population fassent preuve d'une ténacité superflue, en cherchant la possibilité de faire de leur agglomération une station de villégiature de catégorie plus élevée. Leur aspiration n'est que trop naturelle, mais ne correspond pas toujours à la valeur des facteurs de cure. Voici pourquoi, en sortant du cadre des coordonnées des né-

cessités de l'Etat, on risque de s'engager dans des dépenses en argent et en matériaux injustifiées pour l'édification et, ensuite, pour l'entretien et l'exploitation de la station.

9 - Le souci que nous avons à trouver en pratique la solution la plus équitable et la plus économique de nos constructions de villégiature nous oblige à tenir compte de la période durant laquelle nos constructions vont être utilisées au cours de l'année: toute l'année ou durant la saison d'été allongée avec les belles journées du printemps et de l'automne, seulement en hiver ou en été, etc. La solution équitable de cette question est à la base de la solidité et de la complexité de l'édification, la manière et le système de construction des objectifs architecturaux, le genre et le nombre des édifices d'utilité publique, l'échelle des travaux publics, etc.

10 - L'organisation de l'alimentation dans les stations de villégiature est une question à laquelle on accorde une attention toute spéciale. L'alimentation diététique et rationelle, en tant qu'élement du complexe physiothérapeutique, joue un rôle important dans le traitement de plusieurs affections. La thérapie à base de fruits est connue depuis les temps les plus antiques. Grâce à ses excellentes qualités gustatives et thérapeutiques, le célèbre raisin bulgare de l'espèce "Bolgar" constitue la base de l'alimentation diététique dans les stations de cure bulgares. En régie générale, l'abondance de fruits, dont la composition chimique varie selon la région, le sol et les conditions climatiques, contribue à rehausser la qualité et à accorder un caractère spécifique aux cures dans les stations de villégiature bulgares. L'alimentation diététique dans nos stations, qui compose par endroit 85-90% des plats servis, sert de principe directeur lors de la construction des établissements respectifs. L'Institut de l'alimentation auprès de l'Académie bulgare des sciences, l'Institut de physiothérapie et de curologie, ainsi que d'autres organes compétents déploient une grande activité dans ce domaine.

11 - Le sport, les terrains de jeux, les occupations culturelles etc. occupent une grande place dans l'édification des stations de villégiature en Bulgarie. La façon saine et hygiénique, dont les villégiateurs remplissent leurs loisirs, contribuent largement aux bons résultats de la cure. En fait en cela consiste la prophylaxie et l'affermissement de la santé des citoyens.

12 - Les terrains sur lesquels sont construits les bâtiments sanatoriaux sont choisis de façon à avoir la meilleure exposition, baignés par le soleil, bien aérés, les parterres disposant d'une pente d'écoulement suffisante, boisés et pourvus de verdure. Des soins tout particuliers président au choix des terrains pour l'édification des stations de cure balnéaire, où très souvent les eaux gazeuses ou d'une autre composition ne supportent pas le transport à de grandes distances, depuis le griffon de la source jusqu'au complexe de cure. Dans d'autres cas la composition physico-chimique et la température des eaux ne supportent pas un rechauffement supplémentaire à cause de leur passage dans les tuyaux de conduite, etc.

13 - En tenant compte de l'essence physico-chimique et de l'action physiologique, biologique et curativo-prophylactique des facteurs en présence, nous tâchons dans tous les cas de ne pas leur porter atteinte lors des constructions. Dans certains cas l'endroit choisi pour la construction des travaux de service des complexes de villégiature peut s'avérer fatal - centrales de chauffage, noeuds électro-translatifs, buanderies, ateliers de réparations, garages, entrepôts, etc. En règle générale nous cherchons à placer ces élé-

ments, d'une grande importance pour la vie du complexe, en dehors de la zone de cure. C'est là une condition extrêmement importante pour les stations climatiques. De son côté elle donne également d'excellents résultats d'exploitation.

14 - L'établissement des projets et l'édification des objectifs sont réalisés par des organisations d'Etat, qui appliquent dans leurs travaux les dernières nouveautés scientifiques et techniques en étroite collaboration avec les instituts scientifiques compétents et les administrations de direction. Les plans annuels de ces organisations reflètent clairement les tâches de travail complexe exigées par les problèmes qu'elles doivent résoudre.

15 - Les projets urbanistes et d'édification tiennent rigoureusement compte des exigences fondamentales de l'oeuvre de villégiature. Au cours du processus de l'établissement des projets et pour des étapes déterminées on organise une série de conférences où les matériaux sont débattus, afin de conserver et d'améliorer les vertus curatives des conditions naturelles en présence, de rechercher les meilleurs conditions économiques pour l'édification et d'assurer à la station une exploitation bon marché et avec les meilleurs résultats au point de vue médical. De telles conférences sont organisées également au cours des travaux de construction, afin d'éloigner toutes les imperfections constatées au moment de l'exécution.

16 - Les investissements de l'édification des stations de villégiature en Bulgarie proviennent de trois sources - personnes privées, pour l'édification des zones de villas, diverses administrations d'Etat - pour les besoins de leur appareil, et le Conseil central des syndicats ou d'autres organisations d'Etat, auxquelles est confiée la direction du tourisme intérieur et international, la thérapie balnéaire, la culture physique et le sport en masse parmi la jeunesse et la population. De très grandes qualités possèdent surtout les objectifs construits sous la direction unifiée de l'Etat, tant au point de vue de l'utilisation rationelle des terrains de construction, de l'aménagement des travaux publics, etc., qu'en ce qui concerne la présentation d'ensemble, artistique et architecturale, des stations. Tout en satisfaisant à toutes les nécessités fonctionnelles, ce procédé assure également une exploitation à meilleur marché et beaucoup plus effective au point de vue curatif.

17 - Le principe directeur de la disposition dans l'espace et de l'aménagement architectural et artistique des complexes de villégiature en Bulgarie consiste de rapprocher le plus possible les villégiateurs aux éléments de la nature, dont ils sentent la force et le charme dans toutes les circonstances - au cours du traitement, du sommeil ou du repos, durant les repas, la promenade, les jeux, etc. En partant de ces idées, les architectes et les constructeurs se gardent bien d'édifier des bâtiments trop hauts, sauf dans les cas où cela s'impose pour des raisons du terrain, la retouche architecturale de la réalité ambiante ou pour d'autres motifs. Ainsi on permet aux villégiateurs de libérer leur esprit de toutes les images leur rappelant l'ambiance de la ville, où ils habitent et travaillent, ambiance saturée de bruit et de dynamisme. On préfère les vastes cours paisibles et couvertes de verdure. Lors du choix de leur échelle et de la manière artistique et architecturale de leur aménagement, nos constructeurs sont guidés par le sincère désir de suivre et de développer les traditions progressistes de notre héritage architectural national. Ainsi nos stations de villégiature acquièrent un aspect typique. Ces principes

ont été entièrement observés lors de l'édification des complexes maritimes "Droujba", "Les Sables d'Or" et "La Côte de Soleil", la station de cure de boue "Touzlata", etc.

18 - Lors de l'édification des stations de villégiature, le lit apparaît comme un élément essentiel de gabarit et normatif. Le nombre des lits dans une station est en fonction de la capacité du facteur de cure fondamental - le débit de la source minérale, pour une norme moyenne de traitement de 250-300 litres d'eau par lit, la plage, pour une norme de 6 à 10 m^2 par lit, etc. Les maisons de repos et les stationnaires dans les sanatoriums et les balnéosanatoriums sont aménagés principalement avec des chambres à deux lits, la norme étant pour chaque cellule de 8-10 m^2 par lit, avec l'ameublement et l'équipement sanitaire complets. (Fig.I)

19 - Les cadences accélérées actuelles de l'édification des stations de villégiature en Bulgarie constituent un indice positif pour les soins que l'on apporte à la préservation de la santé et de l'aptitude de travail de la population.

a/ En 1961 il y avait en Bulgarie 356 stations de repos. Elles disposaient au maximum de 54,630 lits et le nombre des villégiateurs était de 302,592 personnes. Pour avoir une idée du progrès réalisé dans ce domaine il faut rappeler qu'en 1948 le pays ne disposait que de 102 stations avec 11,500 lits, où prenaient leur repos 91,073 personnes.

b/ En 1961 les stations climatiques (maritimes et de montagne), balnéaires et de cure de boue disposaient de 157 établissements sanatoriaux, avec 15,137 lits. Par rapport à 1939, lorsqu'en Bulgarie il n'y avait que 15 établissements avec 1,443 lits, le nombre des établissements et des lits a augmenté plus de 10 fois.

c/ Le nombre des camps de pionniers, de jeunesse et d'étudiants (auprès de toutes les administrations) était en 1961 de 1,139, Le nombre des campeurs était de 238,787.

d/ Pour l'année courante on a réservé en Bulgarie pour le tourisme international 15,553 lits dans les stations maritimes, 700 lits dans les stations climatiques en montagne, 450 lits dans les campings au bord de la mer, 480 lits dans les objectifs bordant les routes principales, etc.

e/ Les adeptes du tourisme et de l'alpinisme disposent en Bulgarie de 185 chalets, foyers, dortoirs et refuges touristiques, pourvus de personnel, etc. En 1962 trente nouveaux chalets touristiques sont en voie de construction.

20 - Les problèmes du repos et des cures balnéaires de la population de la Bulgarie sont traités (pour la période 1961-1980) sur la base qu'en 1980 la population du pays va s'accroître à 9,258,600 personnes. Le plan général pour 1980 prévoit que les stations de repos vont disposer de 114,000 lits et les sanatoriums et les balnéosanatoriums de 68,000, ce qui leur permettra de satisfaire les besoins de 2,367,000 personnes. Par rapport à l'accroissement escompté (6,961,900 personnes sans les écoliers et les étudiants de toutes les catégories) le fonds des lits va englober 34% de toute la population. Cela correspond à la norme admise (32-36%) pour les effectifs urbains - groupe "A" de la structure de la population.

21 - L'adoption progressive de la journée de travail réduite de 7 heures, dans certaines branches de l'économie nationale - de 6 heures, et de la durée du repos de 20 jours et de la cure dans les stations de 28 jours, font surgir un nouveau problème, celui de rechercher de nouvelles formes d'organisation du repos, surtout du repos hebdomadaire. Dans ce domaine un grand rôle est dévolu aux

stations d'intérêt local, qui sont promises à un grand développement et qui travaillent sur la base existante d'alimentation publique et sous le contrôle direct et par les soins de l'administration locale. Très grand est également le développement des "excursions de repos", qui sont organisées actuellement par le Conseil central des syndicats sur 14 itinéraires.

22 - Dans les environs de presque toutes les villes, agglomérations industrielles et autres, on s'applique sans cesse à créer des conditions pour un repos de courte durée de la population. On a construit des milliers de villas privées ou d'autres établissements ou aménagements d'utilisation publique, qui permettent aux citoyens de se reposer dans une ambiance agréable.

23 - Le repos dans les stations des familles avec des enfants à l'âge préscolaire est également un sérieux problème à résoudre. Une solution satisfaisante, malgré que peu développée pour le moment, est la création des jardins d'enfants et des crèches dans les complexes de villégiature. On s'applique actuellement à trouver des solutions plus conformes de ce problème en prévision des futures édifications de villégiatures.

24 - L'avenir va imposer que l'exploitation des maisons de repos, des balnéosanatoriums et des sanatoriums soit soumise à une seule direction. Actuellement les lits dont disposent les syndicats ne sont utilisés en moyenne que 160 jours par an et la base des administrations qu'environ 91 jours, ce qui n'est pas équitable non seulement du point de vue sanitaire, mais également du point de vue économique.

25 - Pour le moment nos stations maritimes sont les plus recherchées à l'échelle internationale. (fig.II). Le plan régional urbaniste et économique a établi que notre littoral dispose, dans d'excellentes conditions naturelles, d'environ 7,000,000 de m^2 de plages, dont 3,000,000 m^2 de bandes de sables et 4,000,000 m^2 de dunes. Conformément aux normes moyennes adoptées (selon les normes internationales tout visiteur dispose de 6-8 m^2 de bande de sable et de 30-40 m^2 de superficie des dunes) la capacité journalière du littoral bulgare sur la Mer Noire est d'environ 500,000 visiteurs. Ces chiffres offrent de très grandes perspectives pour le développement du tourisme international et de la curologie. Cependant un grand nombre des terrains ne sont pas encore utilisés à cause des grands frais que leur aménagement exige. Sous ce rapport on a entrepris de vastes prospections en vue d'une solution globale de toutes les initiatives, qui non seulement vont conserver, mais également rehausser le standard des stations maritimes bulgares.

26 - Le tourisme et l'alpinisme en masse, qui ont marqué un grand essor surtout après la Deuxième guerre mondiale, découvrent sans cesse pour les amateurs de ces sports de nouveaux itinéraires plus attirants les uns que les autres (Fig.III). La vierge allégresse des montagnes, gardant leur charme depuis le temps d'Orphée, invitent aujourd'hui encore la jeunesse vers leurs cimes immaculées, afin de lui montrer les beautés de notre Patrie. Malgré les difficultés que suscite la réalisation des projets de constructions dans ce secteur de l'oeuvre de villégiature, les perspectives pour l'avenir sont excellentes. On construit sans cesse de très bonnes routes allant jusqu'aux principaux points de sortie, beaucoup de chalets, refuges, téléphériques et autres équipements de nature à faciliter l'accès de la population dans la nature. Les dernières observations viennent prouver que les stations de haute montagne

guérissent avec beaucoup de succès plusieurs affections, surtout lorsqu'il s'agit des stades précoces des maladies.

27 - En Bulgarie il y a beaucoup de grottes souterraines et de précieux monuments historiques de la culture antique, qui font l'objet, au cours des quelques dernières années, de restaurations et d'aménagements par étapes planifiées, afin de les rendre plus facilement accessibles pour le public.

28 - Les inépuisables ressources en eaux minérales sont une véritable richesse pour le pays. Le nombre des gisements d'eaux minérales en Bulgarie est d'environ 90, avec plus de 480 sources d'un débit par 24 h. de 133,000,000 litres. La culture balnéaire est très ancienne en Bulgarie. Les grandes vertus curatives de nos sources minérales sont la cause de la fondation dans l'antiquité de florissantes cités - Pautalia (Kustendil), Serdica (Sofia), Augusta (Hissar), Thermopylis (les Bains minéraux de Bourgas), Thonsos (les Bains minéraux de Sliven), Germanea (les Bains minéraux de Séparevo) et autres, où venaient faire des cures des malades d'Asie, d'Egypte, d'Italie, etc. Les édifices monumentaux (Valetucirium), connus de l'histoire des constructions du Ier siècle et qui servaient d'établissements de cure auprès des sources, font l'objet d'études approfondies de la part des architectes et balnéologistes bulgares, afin d'aménager ces endroits d'après les nécessités contemporaines et les préceptes les plus modernes. On travaille infatiguablement pour prospecter de nouveaux gisements et pour accroître le débit des sources en présence (Fig.IV); on cherche à établir leur composition à l'aide d'analyses et de conclusions pour leurs vertus curatives, les contre-indications, etc.

29 - Les perspectives pour l'édification de villégiatures en Bulgarie sont énormes. Elles inspirent les modestes travailleurs de ce domaine pour des succès futurs encore plus grands.

30 - Les générations, qui connaissent bien et aiment sincèrement les richesses et les beautés de la nature, deviendront sans conteste les plus hardis combattants pour la paix entre les peuples, indépendamment de leur race, appartenance politique ou conceptions religieuses.

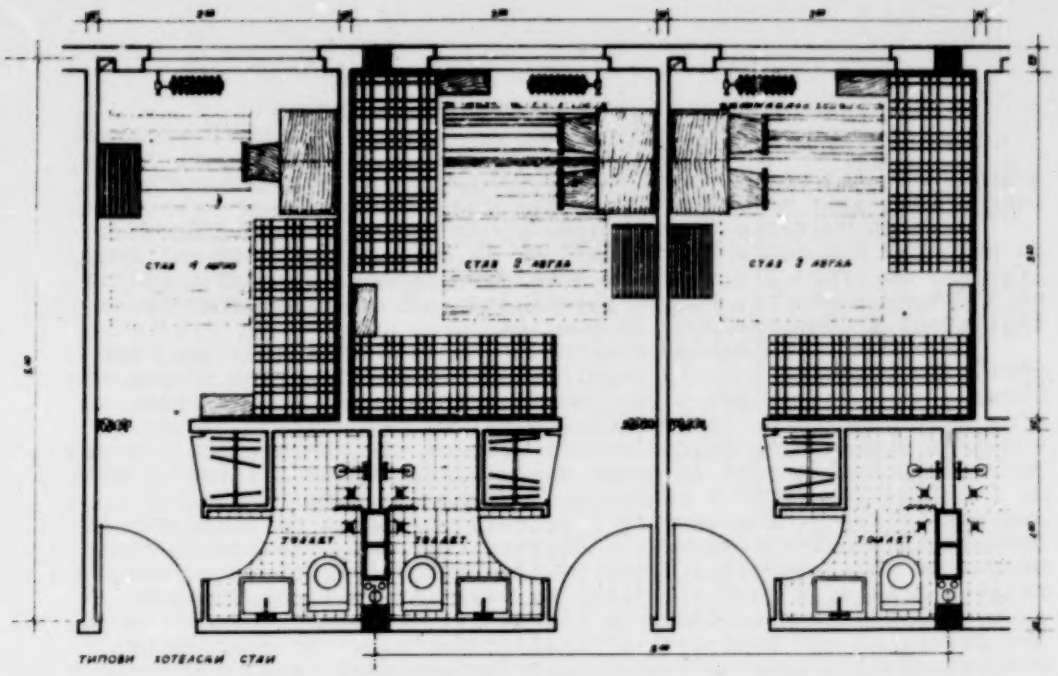
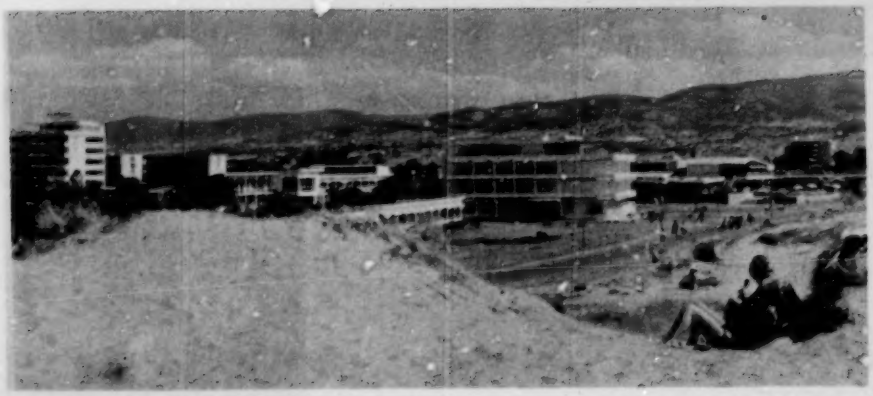


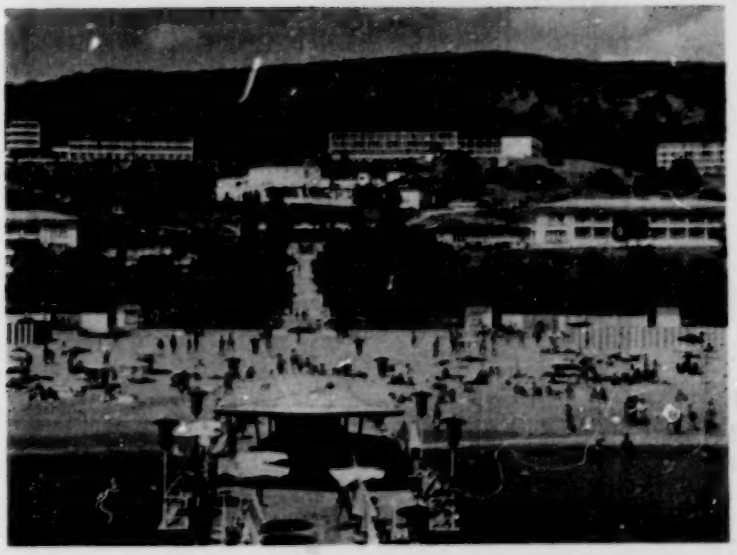
Fig. 1 - Schéma d'une chambre d'hôtel
des stations de villégiature bulgares

(a)

(b)

(c)





(d)

Fig. 2 - Vues des complexes de villégiature "La Côte de Soleil" et "Les Sables d'Or", nouvellement édifiés

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SUMMARY

Agenda Item: D.14

Bulgaria

THE BUILDING UP OF RESORTS IN THE PEOPLE'S REPUBLIC OF BULGARIA

By Todor TODOROV, Architect,
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"Construction of Modern Living Facilities and Amenities" at the State Committee for Construction and Architecture

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THE BUILDING UP OF RESORTS IN THE PEOPLE`S REPUBLIC OF BULGARIA

by TODOR TODOROV - architect,
Head of Department "Construction of Modern Living Facilities and Amenities" at the State Committee for Construction and Architecture

SUMMARY

In the beginning of the report, the author discusses the exceptional role played in the People`s Republic of Bulgaria by research work, which determines the ways and principles to be followed in preserving and getting acquainted with the pristine power of natural factors as one of the most essential conditions in the development of resorts. He points out that this complex research work on the building up of resorts in the People`s Republic of Bulgaria continues until the resorts are ready for exploitation as well as during the period of their exploitation.

Resorts, as factors of preventive medicine in the People`s Republic of Bulgaria, fulfil a very important function in preserving the population`s health and capacity for work. In order to place the development of resorts on the right track and make the construction of resorts serve its true purpose, extensive preliminary research work is carried out:

- to study and safeguard the curative factors at the resorts, with a view to establishing scientific methods for their utilization;
- to undertake technically improved catchments of the existing mineral springs and find out new sources of curative waters and muds;
- to study the material conditions for the development of resorts;
- to select the points of departure and communication links with resort settlements, regions, etc.

Owing to the natural character of the fundamental resort features, in taking count of the well-known classification of resorts into balneological, curative mud, climatic (mountain and seaside) or mixed, Bulgarian town-planning and resort construction have from a practical point of view classed the resorts into three basic groups: resorts for international use, national resorts and resorts of local importance.

The above classification of resorts is based on their curative effects for specific ailments, which in their turn determine their significance and importance; it also helps to map out the conditions and stages in the construction of the resorts.

From a practical point of view, if construction is to be rational and economical, it is necessary to determine the exact periods in which

the resorts will be used - throughout the year, in certain seasons, or otherwise, for this throws light on the question about the solidity and complexity of the constructions, the kind and number of their modern facilities and amenities, their size, etc.

It is underlined that the organization of feeding and the way vacationists spend their leisure, constitute some of the most essential problems in complex therapy and prophylactic work at the resorts in the People`s Republic of Bulgaria.

The question is discussed regarding the organizations entrusted with the designing and construction of resorts in the People`s Republic of Bulgaria, with a view to placing designing on a sound scientific basis; an evaluation is made of their ability to reflect exactly the results of the preliminary investigations of the various factors at the resorts, the means for their preservation, improvement, etc.

Recommendations are given regarding the conditions to which the construction sites have to respond, and indications, by way of example, as to how the properties of the natural factors are to be preserved.

The most effective source of investment funds is determined as an active factor in the designing, construction and exploitation of the resorts.

Methods for laying out the resorts from an architectural and artistic point of view are indicated with a view to preserving and consolidating the curative and prophylactic effects of the natural factors, as well as ways for a successful development of the progressive traditions of the past, so as to lend a typically national character to our resorts.

The bed is taken as basic element in determining the capacity of the resorts with regard to the capacity of their basic curative factors.

An analysis is made of the construction of resorts in the People`s Republic of Bulgaria during the last few years, and comparisons are made by way of example, of the correlation of the total number of beds to the growing population. The author comes to the conclusion that in the nearest future the total number of beds (minus those for students of all categories and those assigned for international use) must embrace 34 per cent of the population, which is equal to the quota (32 to 36 per cent) of the city forming cadres - group "A" in the structure of the population.

Some forthcoming problems connected with the construction of resorts in the People`s Republic of Bulgaria are pointed out as a logical consequence of the tendency of progressive development - reduction of the working day to 7 hours and for some sectors of the national economy - to 6 hours.

Recommendations are made for better utilization of the existing number of beds, deeming it as most expedient to place all resorts under a single state management.

4 photographs are attached to the report as illustrations of the reviewed material.

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ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.7.1

Liberia

FACTORS IN SETTING UP AN IRON AND STEEL INDUSTRY IN LESS DEVELOPED AREAS

By Joseph G. RICHARDS,
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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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FACTORS IN SETTING UP AN IRON AND STEEL INDUSTRY IN LESS DEVELOPED AREAS

BY

JOSEPH G. RICHARDS - MINING ENGINEER - ASSISTANT DIRECTOR, BUREAU OF NATURAL RESOURCES & SURVEYS
REPUBLIC OF LIBERIA

1. INTRODUCTION

This paper is being written without particular reference to any underdeveloped country, but reflects my views as they relate to most, if not all, of the countries in underdeveloped areas.

The words "Iron and Steel" when they are involved in an industry has always been accepted as synonymous with progress other than those that are considered prosaic. What then are the basic factors involved in the creation of an iron and steel industry as they relate to the less developed areas of the world ?

For centuries now, iron and steel have formed part of man's existence and without same, it is almost impossible for him to live and progress along lines of modern and technical advancement. In most of the underdeveloped areas of the world, knowledge of technical know-how is one of the main drawbacks. Because of this dire lack of technical knowledge necessary to the discovery and utilization of natural resources, development in industrialization has lagged. Nevertheless, the demand for industrialization in these areas and an increasing desire to become more self-sufficient serve as motivating factors.

The availability of raw materials - iron, limestone, manganese, coke, gas and/or electrical energy etc., are primary requirements and those countries possessing these resources are in a better position to proceed with less difficulties towards creating iron and steel industries. However, this does not preclude the establishment of similar industries in countries with at least two of such raw materials, because other economic factors would better support and make it profitable to establish within the confines of the country its own steel industry.

Moreover, one cannot dismiss the economic factor implicit in determining the choice of methods used in producing the basic pig iron. Namely, scarcity of technical help, strategically located raw materials, and labour cost. The choice is made easier if prior consideration is given to incorporating related and unrelated secondary industries as well as the establishment of markets away from home.

Another factor that should be considered is the tendency of duplication of major and secondary industries in the less developed areas. I feel quite certain that a greater benefit would be derived in the less developed countries would take a natural resources

inventory and have conferences relative to economic and industrial developement and stagger different types of industrial developement, of which iron and steel is a part, so that less risk may be involved in the procurement of capital which is another major factor.

2. TECHNICAL KNOW-HOW

(a) The technological know-how is an inevitability and while it is true that in many less developed countries this might present a problem, it is equally true that similar problems have been solved in a relatively short time by on the job training under contractural foreign technicians as well as programs designed to send students abroad for higher studies and training. In recruiting foreign technical personnel it is important that the purpose and object of their services be made known. Not only as it relates to their training local help quickly and efficiently but individuals with a sympathetic understanding of the problems involved must be selected. There are very important requisites, for, unless the citizens in these less developed areas are trained to take over from their tutors in a reasonable period of time, a misconception could easily arise.

(b) Semi-skilled workmen can be recruited without difficulty in most underdeveloped areas and unskilled labourers can usually be found in abundance. The semi-skilled workmen, unlike those who must be trained to occupy the skilled or managerial positions, can be trained quickly; therefore, it must be clearly understood that those assigned to train them must not drag out the training programme to fit that of the professional or skilled workmen, which of necessity must take years.

3. RAW MATERIALS

It is unlikely that in any one country all the raw materials needed for the establishment of an iron and steel industry would be found. Therefore, the need frequently arises to supplement local need from foreign sources.

(a) From the knowledge of what goes into the establishment of an iron and steel industry, the ingredients are without exception bulky. Therefore, it is of prime importance that many of the raw materials required be produced locally and as cheaply as possible. The proximity of the source of raw materials to the plant site is most desirable. Iron ore, limestone and/or coal should be available locally, thus minimizing the need and cost of importation.

(b) On the question of importation of other basic raw materials, it goes without saying that this is essential if it cannot be produced locally. But here again, the nearest export market should be sought. The question of a preferential market, and in the light in which this might be viewed, could be a deterrent, especially where outside capital might tend to dictate choice. Nevertheless, this should not be strong enough to justify scrapping the project with other factors remaining favourable.

4. METHOD OF PRODUCTION

Iron and steel technology has progressed today to the place where there are several processes of reducing the ore to its metallic state. In years past, the blast furnaces were the backbone of the

steel industry, perhaps to many it still is. Today, any country, particularly the underdeveloped countries, desiring to embark upon this field must consider besides the blast furnaces other methods of production. Foreign technicians, when called upon to help, must realize that they must enter this endeavour with an entirely different perspective to that they would employ if they were called upon to establish a similar plant in Europe or North America. To many of them there exist problems and conditions that are quite foreign. Therefore, the desire for new techniques that will eliminate the demand for large quantities of raw materials not readily available, must be sought. Because of new techniques such as pelletization of low grade iron ore, birquetting, improved electrical furnaces, better recovery and upgrading of ore from washing plants, the feasibility of establishing an iron and steel industry becomes more attractive and desirable.

This paper does not discard any method of production, but have only stressed that a complete study of all available methods must be made before arriving at a decision. An example of what is meant - let us compare the blast furnace and the electric furnace which are to be used in the production of pig iron in a country possessing iron and coal and an abundance of hydro-electric potential. In the case of the blast furnace, consideration would have to be given to the erection of a coking plant while with the electric furnace, one has to consider the erection of hydro-electric power. Considering all other expenses to be fairly even in an expanding economy in the less developed areas, if where for some reasons the initial costs of the electric furnaces would cost more due to the erection of a hydro plant, but electric power must be had at any rate for domestic consumption and to enable the growth of secondary industry the choice should be for the later, thus minimizing the erection of other electrical power stations. Further, the waste gas from the electric furnace can be used to make fertilizers for agricultural purposes. That is, the reduction gas by the use of steam could be converted to a gas rich in hydrogen and by removing the carbon dioxide could be transformed to ammonia by using nitrogen from an air disintegration plant. The ammonia thus produced could be the basic material in the production of the above mentioned fertilizers.

5. SOCIO-ECONOMIC & POLITICAL CONSIDERATION

As the economy of a nation grows and becomes more complex, a wider choice of alternatives has to be considered. In principle, industrialization aims at finding the right combination of investment, technological and institutional changes and other measures which will produce the greatest economic results to the economic complex.

No single sector can be isolated from the entire economic complex if the greatest good is to be achieved. The analytical techniques employed must therefore incorporate the mechanism for choosing among various alternatives as well as a way of achieving consister results.

In underdeveloped areas, the significant use of available resources is an essential factor of primary economic consideration.

Industrialization is an expensive and complex undertaken involving enormous capital outlay and the use of various categories of labour - highly technical, skilled as well as semi-skilled and unskilled labour, must be available in large numbers to meet local demands of industries.

The major considerations therefore facing underdeveloped countries seeking to industrialize theri natural resources fall into two distinct categories, namely: the socio-Economic and the Political.

(a) Socio-Economic Implication - The first consideration involves the availability of capital and foreign exchange which are indeed scarce in most underdeveloped countries. Owing to the scarcity of capital and foreign exchange, most underdeveloped countries have had to make the alternative decision between inviting foreign investment through the granting of concession rights, or permitting their resources to remain dormant. This latter choice has given place to the view that the physical resources of a nation serve that nation and its people best when it can be converted into meaningful physical wealth capable of satisfying the social and economic needs and aspirations of that nation and its people. Evidently, this choice is motivated by national policy designed to increase national income, provide more employment opportunities, expand international trade and commerce with a view of creating a favourable balance of trade and distribute the wealth of the country more equitable among its people. Local capital should be encouraged to participate in the industrial growth of the country. Not only does this brings about a feeling of ownership, but the entire meaning of progress through the encumbent change that must follow will lead to a speedier overall developement programme. It must be pointed out here that collective association of the nature required to raise enough money to float the venture of the establishing of an iron and steel plant would be something strange to most people living in underdeveloped areas and it is left with local authorities to convince its citizens to participate by making certain guarantees that could not be made by foreign investors in the event this is a foreign undertaking with local participation.

(b) Political (i) (Local) - However, in order to achieve these broad objectives, a favourable political climate becomes a prerequisite, namely: stable government, favourable tax treatment, consistent economic policies, free enterprise system and the existence of a promising political complexion which minimizes the risk of possible nationalization; especially so, when the establishment of types of industries call for sizeable outlays, which in most instances must be foreign.

In addition to these, the convertibility of currency is also an essential factor which has both economic and political implications of some magnitude, but which deserves prior consideration within the context of this paper. In brief, except the investing country think in terms of the easy convertibility of the currency of the host country, into its own currency or some other acceptable currency, the prospects of investment becomes shrouded in clouds and unattractive.

(ii) Political (Regional) - One other factor of primary political consideration to underdeveloped countries tending towards industrialization is the need to avoid duplication of types of industries in areas enjoying close proximity.

A better view seems to favour close collaboration among underdeveloped countries to bring specialized types of industries capable of producing a variety of the economic needs of the region with emphasis on specialized industries rather than on duplication of these economic goods and services in too great a volume

to be economically advantageous to the region; especially in view of the present trend towards the formation of economic groupings among European Countries. i.e., An oil refinery in countries like Ghana, the Ivory Coast, and Liberia with contiguous boundaries is hardly advantageous to the West African region. But why in the first place an oil refinery in any of these countries rather than Nigeria with obvious advantages to all countries in the region ?

From an investment point of view, this would seem a more attractive prospect to investors. This point of view seems to be the answer to the European market and the E.E. community and provides a healthier environment for inter-regional trade amongst the countries and protection for the region's trade against exclusion from European markets.

With all these factors, technical know-how, raw materials, method of production, socio-economic and political taken into consideration and in their right perspective, the underdeveloped nations can industrialize at a faster pace since they have the advantage of abundant and untapped natural resources. Also the fact that many countries in North America and Europe are looking for markets to invest overseas. Finally, many costly experiments due to trial and error methods can be avoided.

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SUMMARY

Agenda Item: D.7.1

Liberia

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By Joseph G. RICHARDS, Mining Engineer,
Assistant Director,
Bureau of Natural Resources and Surveys,
Republic of Liberia

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FACTORS IN SETTING UP AN IRON AND STEEL INDUSTRY IN LESS DEVELOPED AREAS
(Serial No. 3111 - Sub. Item D.7.1)

BY

JOSEPH G. RICHARDS - MINING ENGINEER -ASSISTANT DIRECTOR, BUREAU OF NATURAL RESOURCES & SURVEYS
REPUBLIC OF LIBERIA

SUMMARY

The major factors involved in setting up an iron and steel industry in underdeveloped areas may be listed as follows:-

Technical know-how. This involves the technicians necessary for the discovery and utilization of natural resources. Associated with the technicians are the semi- skilled and unskilled workmen. Unlike the technicians the later classes of workmen can usually be found in abundance in the underdeveloped area. However, the lack of technicians should not create too much of a problem since contractual personnel can be had as well as on the job training of local personnel can be effected.

The second major concern is the raw material necessary to lunch such an industry. Raw materials such as iron, limestone, manganese, coke, gas and/or electrical energy. Those underdeveloped countries possessing most of these materials are in a better position to proceed with less difficulties. However, countries with at least two of the basic raw material may not necessarily be handicapped in setting up an iron and steel industry, because other economic and political factors might be favourable.

The method of production also is a decisive factor. This is influenced mainly by the availability of raw materials; therefore, the desire for new techniques that will eliminate the demand for large quantities of raw materials, not readily available, must be sought. Because of new techniques such as pelletization of low grade iron ore, birquetting, improved electrical furnaces, better recovery and upgrading of ore from washing plants, the feasibility of establishing an iron and steel industry becomes more attractive and desirable. After cost studies have been made for initial setting up of an iron and steel plant, the cheaper should not dictate a particular method and serve as the sole criteria, but rather a broader view that will incorporate national development should prevail,i.e. Where an abundant supply of water exists there should be prior consideration for erection of a hydro plant for electrical energy to be used in the electric furnace for the production of pig iron as against a blast furnace. This plant would not only furnish the power for production of pig iron by use of the electric furnaces, but the additional power, which is usually in short supply in underdeveloped area, can be used for domestic purposes as well as in secondary and non-related industries.

Other factors that should be considered are the socio-economic and political factor. As the economy of a nation grows and becomes more complex, a wider choice of alternatives has to be considered. In principle, industrialization aims at finding the right combination of investment, technological and institutional changes and other measures which will produce the greatest economic results to the economic complex. Hence one of first consideration involves the availability of capital and foreign exchange which are indeed scarce in most underdeveloped countries. Because of this, most underdeveloped countries have had to make the alternative decision between inviting foreign investment through granting of concessions right, or permitting their resources to remain domant.

Where foreign investors are invited to participate a favourable political climate becomes a prerequisite, namely: stable government, favourable tax treatment, consistent economic policy, full enterprise system and the existence of a promising political complexion which minimizes the risk of possible nationalization; especially so, when the establishment of types of industry calls for sizable capital outlays.

Finall, duplication of types of industry must be avoided in favour of staggering them, giving priority to conntries possessing the best economic and political justification. To achieve this, close collaboration among the underdeveloped countries should be undertaken with a national resources inventory a necessity. Also a comprehensive economic survey of markets must be undertaken.

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Point de l'ordre du jour : D.8.1

Belgique

LAVERIES MOBILES ET SEMI-MOBILES POUR LA CONCENTRATION DES MINERAIS STANNIFERES

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d'Entreprises Minières

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LAVERIES MOBILES ET SEMI-MOBILES POUR LA CONCENTRATION DES MINERAIS STANNIFERES

Alexandre Prigogine

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1. Introduction.

En principe, nous pouvons envisager trois types de laveries mobiles ou semi-mobiles conçues pour l'exploitation de petits gisements (1) :

-les laveries mobiles montées complètement sur des chariots ou directement sur des camions;

-les laveries semi-mobiles dont les machines sont montées à l'aide de profilés facilement démontables, formant ainsi des unités très compactes;

-les laveries semi-mobiles constituées simplement par des machines déposées sur le sol et reliées entre elles par des transporteurs à courroie, des élévateurs, des pompes ou des goulottes suivant la pente du terrain.

En général, et spécialement en terrain accidenté, il est plus facile d'utiliser des laveries démontables des deux derniers types. Les machines seront alors montées soit sur un chassis en profilés, soit simplement sur des patins ou sur des madriers en bois. L'emploi du ciment sera réservé à quelques fondations absolument indispensables.

Pour des questions de qualification de la main-d'oeuvre, de pièces de rechange et d'éloignement des ateliers, les laveries proposées doivent être autant que possible standardisées et comporter un matériel robuste, d'un entretien facile.

Nous limiterons la discussion aux laveries pour le traitement des minerais stannifères qui cependant peuvent servir à la concentration d'autres minéraux de valeur à densité élevée.

2. Concentration des minerais alluvionnaires et éluvionnaires.

a) Laveries à sluice.

Les laveries à sluice gardent toute leur importance pour l'exploitation de petits gisements spécialement dans les régions d'un accès difficile ne disposant pas de force motrice bon marché, mais, par contre, d'un réseau hydrographique approprié. C'est ainsi qu'on ne connaît aucun autre appareil de concentration qui permette d'exploiter avec bénéfice de petits affluents étroits où la couche du gravier a une faible épaisseur.

Le sluice est capable de retenir, en absence d'argile et pour une faible proportion de sables noirs, 91 % d'or -0,5 +0,3 mm et 85 % de cassitérite -1 + 0,5 mm (2). Cet appareil convient donc parfaitement pour la concentration de graviers aurifères et stannifères, si la proportion d'or ou de cassitérite à respectivement -0,3 et -0,5 mm est faible.

(1) Les laveries flottantes ou montées sur chenilles, de grande capacité, alimentées le plus souvent par des draglines, sortent du cadre de notre sujet.

Le prix de revient du lavage d'un m3 de gravier (3), dans un simple sluice de 40 cm de largeur, d'une capacité horaire effective de 1,5 m3 de gravier, n'exigeant qu'un seul ouvrier-laveur (4) est de 9 F (5).

Dans le cas d'une laverie plus perfectionnée (double grizzly, élément primaire de 200 cm, classeur à courant porteur, undercurrent), traitant 60 m3 de gravier par poste de 8 heures et demandant 5 ouvriers, le prix de revient du traitement peut être calculé à 11 F, amortissements compris.

b)Laveries mécanisées.

L'unité de base des laveries mécanisées mobiles ou semi-mobiles est le jig qui, à surface égale, peut traiter un tonnage 10 à 20 fois supérieur à celui d'une table à secousses, tout en coûtant seulement deux fois autant. De plus, l'emploi du jig est justifié par les résultats obtenus récemment en Nigérie et en Malaisie (6) qui ont montré qu'il est possible d'étendre sensiblement la récupération du jig vers les fines granulométries en éliminant les boues et l'eau en excès dans l'alimentation du jig à l'aide d'hydrocyclones.

On choisira un jig léger (modèle 36"x36") du type à diaphragme. Pour le finissage, on s'adressera à un jig du même type où à un jig antisuccion.

Le classement en tête des laveries peut être effectué à l'aide d'un classeur fixe (grizzly, grille courbe, classeur à courant porteur), d'un trommel (pour graviers argileux) ou d'un crible vibrant.

Lorsque la hauteur nécessaire (3-4 m) au fonctionnement d'un hydrocyclone primaire n'est pas disponible, il faut s'adresser à une pompe à gravier. Ceci complique singulièrement l'installation et sa réalisation est réservée aux laveries d'une certaine importance (supérieure à 20 m3/h). Lorsque la laverie est alimentée par un élévateur hydraulique, l'eau en excès contenant l'argile en suspension est éliminée à l'aide d'un classeur à courant porteur.

Suivant le perfectionnement de la laverie, nous pouvons envisager un à trois étages de concentration. Le tableau 1 montre le flow sheet de quelques laveries typiques ainsi que les caractéristiques des appareils nécessaires pour leur réalisation pratique.

Le schéma L11 ne convient qu'aux petites installations et encore seulement si le gravier ne contient pas un pourcentage élevé de cassitérite fine. Beaucoup de laveries de moyenne importance sont conformes aux schémas L21 et L22. Les schémas L23 et L3 doivent être employés si le gravier est fortement argileux ou si l'alimentation est à une dilution élevée. La table à secousses(ou spirales) du schéma L3 évite la formation d'une charge circulante en cassitérite fine, lorsque la proportion de cette dernière est importante.

Les tableaux 2 et 3 montrent respectivement le coût des laveries décrites précédemment, calculé en nous basant sur les prix de revient des machines(rendues au Kivu), et le prix de revient du traitement d'un mètre-cube, sans et avec amortissements (7)(8).

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(2)A.Prigogine, Récupération de l'or par sluicing, Mém.Inst.Roy.Col.Belge, Sc. techn., in-8°, VII, fasc. 1, 91 (1952); Echantillonnage et analyse des minerais hétérogènes à faible teneur, Mém.Acad.Roy.Sc.Outre-Mer, Sc.techn.,in-8°, XV, fasc. 1, 128 (1961).

(3)Nous insistons sur le fait que les prix de revient cités dans cet article se rapportent au traitement seul.

(4)Le coût d'un ouvrier a été admis à 100 F. Ce chiffre varie évidemment d'un pays à l'autre et figure seulement à titre indicatif pour permettre les comparaisons.

(5)Tous les prix cités dans cet article sont exprimés en francs belges.

(6)Voir les publications de F.A.Williams, J.H.Harris et I.R.M.Chaston.

(7)Les appareils, moteurs et alternateurs sont amortis en 20.000 heures; les frais de déplacement, de préparation du terrain et de montage en 6 mois (1.200 heures).

(8)Dans le cas des laveries mécanisées demandant d'importantes immobilisations de capitaux, il est souhaitable de travailler à deux et même à trois postes.

TABLEAU 1

Réalisation pratique des laveries pour graviers alluvionnaires

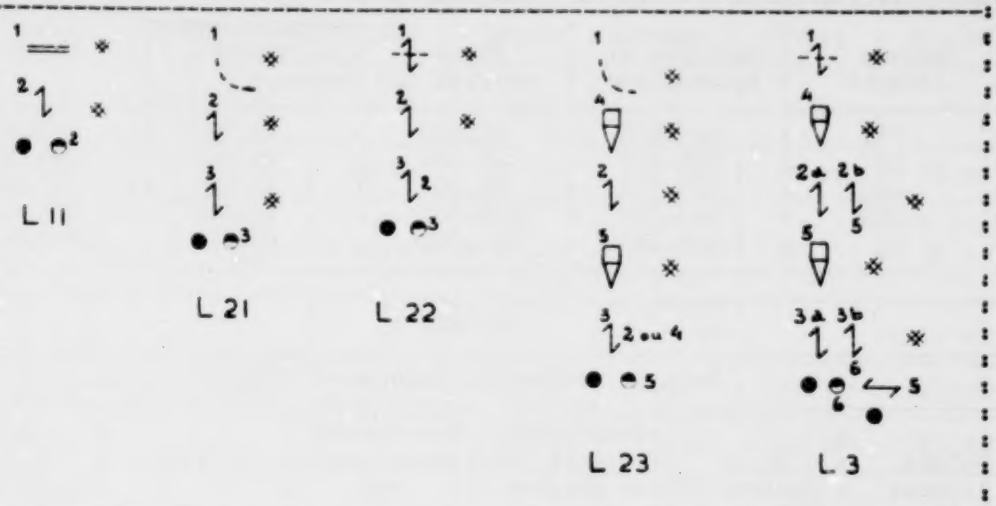

Schéma	L11	L21	L22	L23	L3
Capacité m3/8 h	30	60	60	150	150
1 Classeur	+	+	3'x6'	+	4'x8'
4 Hydrocyclone	-	-	-	(1)32"	(1)32"
2 Jig dégrossisseur	(1)36"	(2)36"	(2)36"	(3)36"	(3)36"
- Elévateur ou pompe	-	EH	P2"	P3"	P4"
5 Hydrocyclone	-	-	-	(1)10"	(2)10"
3 Jig finisseur	-	(1)36"	(1)36"	(1)36"	(1)36"
6 Table à secousses	-	-	-	-	+
Puissance inst.CV	3	9	15	17	42
Energie cons.CVh/m3	0,53	0,80	1,33	0,64	1,60
Main-d'oeuvre	3	2	2	2	3

EH : Elévateur hydraulique P : Pompe à sable

Comparons ces prix de revient avec ceux d'une laverie à sluice. Nous avions calculé précédemment le prix de revient du traitement d'un m3 à environ 10 F. La différence varie donc, suivant le schéma de la laverie admis (en excluant L11), de 1,21 (L23) à 11,89 F (L22). Elle correspond à une récupération supplémentaire de 0,02 à 0,2 kg de cassitérite (9) par m3 traité. Cette quantité est relativement faible et il existe des gisements où cette récupération supplémentaire sera facilement obtenue. Comme contre-partie, il faut citer l'importance du capital investi et l'entretien plus compliqué des laveries à jigs. Ces deux points peuvent faire adopter une laverie à sluice, même si la récupération escomptée est plus faible.

(9)Nous avons admis 60 F pour la valeur carreau mine d'un kilo de cassitérite.

TABLEAU 2

Coût des laveries pour graviers alluvionnaires

Schéma laverie	Machines et accessoires	Force motrice (a)	Prépar. terrain: déplacement, montage	Total
L11	145.000	25.000	10.000	180.000
L21	428.000	40.000	25.000	493.000
L22	585.000	95.000	35.000	715.000
L23	663.000	100.000	45.000	808.000
L3	1.532.000	290.000	90.000	1.912.000

TABLEAU 3

Prix de revient du traitement d'un m3

Schéma laverie	Frais directs (b)	Amortissem. laverie, force motrice	Amortissem. déplacement etc.	Total	Q.P. force motrice
L11	18,51	2,27	2,23	23,01	2,51
L21	10,90	3,13	2,78	16,81	2,33
L22	13,46	4,53	3,90	21,89	4,29
L23	7,23	1,98	2,00	11,21	1,97
L3	11,54	4,86	4,00	20,40	4,64

3. Concentration des minerais filoniens.

Les laveries gravimétriques pour minerais stannifères comportent une section de fragmentation et une section de concentration. Vu la faible capacité horaire de ces unités, le concassage doit être limité généralement à environ 18 mm, avec un minimum de 8 mm qu'il est difficile de dépasser. Ce résultat peut être atteint normalement en un ou deux étages de concassage, en travaillant en circuit fermé avec un tamis vibrant, pour arriver au diamètre de 8 mm.

Une grande simplification de la section de fragmentation peut être obtenue par l'emploi d'un broyeur à percussion. Il permet de réaliser un rapport de réduction très élevée et possède une capacité horaire importante par rapport à son poids. Toutefois, il ne convient pas aux minerais durs pour lesquels il conduit à un prix de revient prohibitif.

La section de concentration sera basée sur l'emploi de jigs. Le sluice peut servir comme pis-aller, dans le cas de laveries de très faible capacité (0,5 à maximum 2 t/h). Le minerai concassé, anguleux, se prête mal à la concentration par sluicing, les mixtes étant perdus en majeure partie. Il en résulte que le rendement de récupération d'un jig est nettement supérieur à celui d'un sluice.

L'ensemble du minerai concassé sera traité, sans classement, dans un jig qui retient même des mixtes relativement pauvres, surtout s'il est muni de quatre compartiments. Il faut prévoir de plus un broyage supplémentaire de ces mixtes pour libérer la cassitérite. Autrement, les flow sheets de ces laveries

(a) En dessous de 12 CV, la force motrice sera fournie par un moteur Diesel; au-dessus de cette valeur par un groupe électrogène.

(b) Les frais directs comprennent la main-d'oeuvre, la force motrice (combustible, fournitures, entretien), les fournitures, l'entretien et les divers.

TABLEAU 4

Réalisation pratique des laveries pour minerais stannifères primaires

Schéma	C12L10(c)	C12L11	C21L21	C22L22M(d)	C11L22	C13L3M
Capacité en t/h	0,5	2	5	5	15	15
Concassage à	25 mm	25 mm	18 mm	8 mm	20 mm	12 mm
1 (e)	GF	GF	GF	GF	-	TV 4'x8'
2	G 5"x6"	G 8"x10"	G 9"x16"	G 9"x16"	BP 1	BP 1
3	-	-	TV 2'x4'	TV 2'x4'	-	-
4	-	-	G 9"x16"	R 25"x14"	-	-
5	-	-	-	R 16"x10"	-	R 16"x10"
Dégrossisseur	S30	(1)J26"	(1)J36"	(1)J36"	(2)J36"	(2)J36"
Finisseur	-	-	(1)J18"	(1)J18"	(1)J36"	(2)J26"
Puissance inst.CV	5	12	46	65	37	67
Energie cons.CVh/t	6,00	4,50	6,80	9,20	1,52	2,80
Main-d'oeuvre	3	4	4	3	4	4

(e) 1 Crible primaire — BP1: Broyeur à percussion SAP1 — J : Jig
2 Concasseur primaire — G : Granulateur — R : Broyeur à rouleaux
3 Crible secondaire — GF : Grizzly fixe — S : Sluice
4 Concasseur secondaire
5 Broyeur pour mixtes

C11 Concassage en un étage, sans criblage
C12 idem , en circuit ouvert, avec criblage préliminaire
C13 idem , en circuit fermé , avec criblage préliminaire
C21 Concassage en deux étages, en circuit ouvert
C22 idem , en circuit fermé pour le second étage

seront semblables à ceux discutés précédemment (sans classeur en tête). L'emploi des hydrocyclones est justifié seulement si le minerai est argileux ou si la dilution à l'entrée de la section de concentration est trop élevée.

Les deux sections de la laverie doivent être équilibrées : plus la section de fragmentation est complète, plus la section de concentration doit être perfectionnée et vice versa.

Nous avons réuni, dans le tableau 4, les caractéristiques des appareils préconisés pour quelques laveries typiques. Il est possible d'atteindre même une capacité horaire de 15 t/h, mais en s'adressant au broyeur à percussion (p.ex.pour le traitement de pegmatites plus ou moins décomposées).

(c)L10 désigne un sluice.
(d)La lettre M indique que les mixtes sont broyés dans un appareil spécial.

Le coût de ces laveries et le prix de revient du traitement, en supposant que les laveries travaillent à un seul poste de 8 heures, résultent des tableaux 5 et 6.

TABLEAU 5

Coût des laveries pour minerais stannifères primaires

Schéma laverie	Machines et accessoires	Force motrice	Prépar. terrain, déplacement, montage	Total
C12L10	46.000	30.000	5.000	81.000
C12L11	257.000	45.000	20.000	322.000
C21L21	734.000	320.000	50.000	1.104.000
C22L22M	1.400.000	410.000	80.000	1.890.000
C11L22	654.000	190.000	50.000	894.000
C13L3M	1.989.000	410.000	120.000	2.519.000

TABLEAU 6

Prix de revient du traitement d'une tonne

Schéma laverie	Frais directs	Amortissem. laverie, force motrice	Amortissem. déplacement etc.	Total	Q.P. force motrice
C12L10	155,00	7,60	8,32	170,92	24,00
C12L11	69,60	7,55	8,35	85,50	13,22
C21L21	47,75	10,54	8,34	66,63	19,20
C22L22M	54,70	18,10	13,37	86,17	25,30
C11L22	15,17	2,82	2,78	20,79	4,37
C13L3M	20,28	8,01	6,68	34,97	7,70

Si nous excluons la laverie de 0,5 t/h, nous constatons que le prix de revient du traitement, amortissements compris, des laveries d'une capacité de 2 à 5 t/h, comprenant des concasseurs classiques, varie de 67 à 86 F, ce qui correspond à une teneur de 1,1 à 1,4 kg/t de SnO_2. Le dernier chiffre s'applique déjà à une installation assez perfectionnée, avec broyage à -8 mm. Les laveries, où la fragmentation est faite à l'aide d'un broyeur à percussion, conduisent à un prix de revient particulièrement faible, de 21 à 35 F, soit de 0,350 à 0,580 kg/t, à condition que le minerai ne soit pas abrasif.

En remplaçant le sluice (L10) par un simple jig (L11), le prix de revient du traitement augmente de 53 F (10), pour une laverie de 0,5 t/h, et de 19 F, pour une laverie de 2 t/h. Cette différence correspond à respectivement 0,9 et 0,3 kg/t. Comme, surtout dans le premier cas, le minerai (récolté normalement par glanage) envoyé à la laverie doit avoir une teneur élevée, pour que l'exploitation soit rentable, on arrive à la conclusion que le remplacement du sluice par un jig est justifié.

Notons encore, pour terminer, que ces laveries peuvent servir comme unités d'échantillonnage et même de laveries-pilote, si l'exploitation montre que le gisement possède, en réalité, une extension considérable.

(10) Ce chiffre élevé est dû principalement à la main-d'oeuvre plus nombreuse (4 ouvriers contre 3 à la laverie C12L10).

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ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: D.8.1

Belgium

MOBILE AND SEMI-MOBILE ORE WASHERS FOR THE CONCENTRATION OF STANNIFEROUS ORES

By Alexandre PRIGOGINE,
Agrégé de l'Enseignement Supérieur,
Docteur en Sciences, Membre de l'Académie
Royale des Sciences d'Outre-Mer,
Directeur du Service Métallurgique
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et de la Compagnie Belgo-Congolaise
d'Entreprises Minières

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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No.4217
D.8.1.

MOBILE AND SEMI-MOBILE ORE WASHERS FOR THE CONCENTRATION OF STANNIFEROUS ORES.

by Alexandre PRIGOGINE,
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Semi-mobile washers are best suited for the exploitation of small ore deposits under the conditions prevailing in developing countries. These washers must as far as possible be standardised and include only sturdy equipment of easy maintenance.

According to the granulometry of cassiterite in detritic ores concentration can be carried out either in sluice washers in jigwashers. When the percentage of 0.5 mm. cassiterite is not high, the sluice system is perfectly suitable for requirements in little developed countries, providing that the hydrographic system is appropriate for this utilisation. Yields of recuperation higher than 90% are obtainable, if the gravel is not too loamy and does not contain much black sands. On the other hand when the proportion of 0.5 mm. cassiterite is considerable, the utilisation of sluices would lead to high losses. Jigs must in that case be used for they are suitable for fine granulometries, if excess water and floating muds are eliminated through anticyclones.

Several typical semi-mobile washers are described with indications of characteristics of the equipment necessary for their practical realisation. According to capacity (from 30 to 150 m3 for 8 hours) and the rate of perfection of these washers, their cost goes from 180,000 B.F. (one unique jig with two compartments) up to 1,912,000 B.F. for a more elaborate washer (vibrating screen, hydrocyclones, sand pump, several jigs with four compartments). The cost of the treatment alone, amortisation included (for 20,000 hours) varies from 11 up to 23 fr. per cubic meter.

Additional recuperation from 0.02 to 0.20 kg. cassiterite per cubic meter treated would then indeed justify the installation of a mechanised washer.

Nevertheless, the importance of the invested capital and the more complicated maintenance of jig washers may lead to adoption of a sluice washer even if the anticipated recuperation is lower.

The fragmentation section of the washer for the handling of primary stanniferous ores generally includes classical crushers (granulators, roll crushers). It is then possible to get crushing of roughly 25 mm. in a single stage, and of 8 mm. in two stages, the latter one enclosed circuit. In the case of such washers, capacity is limited to a maximum of 5 t/h, because of the weight of the comminution engine.

When the low abrasive power of the ore allows utilisation of a percussion crusher, one can even reach a capacity of 15 t/h, with a very simple fragmentation section, including no heavy machines. In some cases, selective crushing can be realised and is then particulary advantageous.

The sluice is not very well suited for the concentration of crushed ore. As, in any case, the fragmentation section requires machines impulled by an appropriate source of energy (Diesel engine or generating set, according to the power needed) utilisation of jigs is not a special complication and this solution should be adopted in all cases of concentration of primary stanniferous ores.

The practical realisation of several typical washers of a capacity varying from 2 to 5 t/h, is explained in detail with the characteristics of the equipment required. The cost price of these washers varies from 322,000 B.F. up to 1,890,000 B.F. according to the degree of fineness of the crushing operation obtained and according to the degree of perfection of the section of concentration.

The expense for treating one ton, amortization included, is from 67 to 86 B.F. When the section of fragmentation includes a percussion crusher it rises to a price of 894,000 up to 2,519,000 F. for a 15 t/h washer in proportion with the flowsheet of the section of concentration. In this case, the cost of the treatment, amortization included, is particularly low : 21.-Fr. and 35.-Fr. per ton respectively.

It also must be noted that the washers as described may be used for the concentration of other high density mineral ores, such as gold (alluvium and eluvium only, wolframite and columbotantalite).

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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item : D

United Kingdom

DIFFICULTIES OF MECHANIZATION IN LESS-DEVELOPED AREAS

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DIFFICULTIES OF MECHANIZATION IN LESS-DEVELOPED AREAS

by S.J. Wright, M.A.
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1. This paper is based in the main on what the writer has seen for himself, or heard at first hand, during visits to nine less-developed countries in the Middle East, South East Asia, and Africa. In all of them agricultural mechanization of one kind or another has been, or is being, undertaken. In all of them much the same difficulties have been, or will be, experienced. The purpose of the paper is to discuss the causes underlying the difficulties; and to suggest possible ways of alleviating them. In the discussion there will be three distinct aspects of mechanization to consider.

(a) First, there is what may be called "Land-Use Mechanization" - i.e. the use of mechanical equipment for such purposes as clearing new land or reclaiming derelict land; for large-scale soil conservation or the preparation of new irrigation areas. This stands apart because ordinarily the equipment concerned will be too heavy or too specialised for everyday use on the same land afterwards.

(b) Secondly, there is straightforward farm mechanization - i.e. the adoption of much the same kinds of tractors and other modern appliances as are commonly used in more-developed countries; by plantations, estates and such ordinary farm holdings as are large enough to own them individually and use them economically.

(c) Finally, and more importantly in the long run, there is mechanization in the wider sense of whatever can be done to bring mechanical aids to the service of the very small peasant holdings which, in most less-developed areas, will account for the greater part of all farm land.

2. In setting out the background to this discussion it should be noted that in the areas with which this Conference is concerned the two incentives of labour shortage and rising labour costs, which have mainly conditioned the development of mechanization elsewhere, will not ordinarily exist. Only rarely will there be any general scarcity of workers; more commonly they will be plentiful enough to make fears of unemployment something of an obstacle to the whole idea of mechanization. Nor, where family farms operating at or near the subsistence level are likely to predominate, can labour costs have very much significance. At least, so far as this generation is concerned, anything like widespread mechanization of the agriculture of less-developed areas can be justified, if at all, only by increased production of food or fibre.

3. One obvious instance is the land-use mechanization already mentioned, much of which aims ultimately at increasing the effective area of farm land. Over the last fifteen years in India, for example, some hundreds of thousands

of acres, derelict through complete infestation with rhizomatous weeds, have been brought back into cultivation by deeper ploughing than could be done without mechanical power. But in most countries the areas which can be developed at all economically as entirely new farmland are relatively limited; while reclaiming derelict land raises immediately the problem of keeping it productive afterwards. Almost everywhere a far greater potential opportunity will lie in overcoming whatever factors may limit productivity on the land that is already in cultivation.

4. Some factors like poor seed, lack of chemical or other manures, and inadequate crop protection which are known to limit productivity have nothing directly to do with mechanization. On the other hand, particularly under monsoon conditions in which all the work of soil preparation and seed sowing has to be crowded into a few weeks following the rains, one major limiting factor is the very low work output of the typical team of draught animals. Their pulling ability is poor, they are slow-moving both in getting to and from their work and in the work itself, and they need to stop frequently for rest or watering. In consequence the whole useful output of a peasant's pair of bullocks is probably no more than four or five horsepower-hours a day; and, in what is necessarily a short working season, this is very often not enough for what needs to be done.

5. The weed-derelict land already mentioned is itself evidence of the outcome in some areas. The weeds in question - Kans grass, Harialı and Kundah - all spread from one field or farm to another by seeding; and it is only after they have established themselves that specialised equipment is necessary to get rid of them. In their early stages they can be controlled, and by farmers with resources enough are controlled, by thorough and timely working with whatever indigenous tillage tools are ordinarily used. But the work falls to be done in the same brief period following the rains; and, where cultivators face the short-term alternative that their families will go hungry if crop sowing is delayed, is likely not to be done thoroughly enough.

6. Nor are the limitations of draught animals confined to the districts in which weeds like these are prevalent. Around almost any peasant village, and in almost any season, one can see pieces of land lying idle which, given more time or more power, would have been under crop. On cropped land one can see poor crops resulting from late sowing. Again, in many areas with ample water for irrigation, the fact that only a small proportion of the land is double-cropped results from the same basic cause.

7. Against this background the difficulties of mechanization are all, in the final analysis, economic. There is indeed only one all-embracing difficulty; that in less-developed areas mechanization costs too much. On the one hand, there are the relatively high capital costs of equipment which limit individual ownership to a very small proportion of farmers. On the other, there are the excessively high operating costs arising from inefficient usage, high incidence of breakdowns and repairs, and too rapid depreciation of machines. Alongside these there is very commonly the complaint that the service and repair facilities offered by local agents and distributors are inadequate.

8. The difficulty of providing equipment cheap enough for small-scale farmers to own for themselves exists wherever mechanization is in its early stages. In the past it has existed in all the countries in which mechanization is now well advanced; in some of them, where more elaborate

appliances for saving hand labour are concerned, it still exists. But in these more-advanced countries, what is the real core of the difficulty from the standpoint of less-developed areas - to provide small farms with tractors so as to replace animal power - has tended to resolve itself by what may be called mechanization from the top downwards.

(a) What has happened in the United Kingdom provides one illustration. The main feature of downwards mechanization is that tractors and tractor implements which become obsolescent on the large farms which first buy them are passed down to smaller ones. They are "traded-in" as part of the purchase price of newer ones; and then, generally after reconditioning, are resold, second-hand but still thoroughly serviceable, at prices well below their original cost.

(b) But in the United Kingdom at the outbreak of war, when by present standards mechanization was only just beginning, there were already 50,000 tractors, or roughly one to every 250 acres of arable land; while five years later, and as a direct consequence of the war, there were three times as many. In the meantime, ideas on large-farm mechanization had developed very considerably: the tractor was no longer only, or even mainly, a source of pulling power. In addition to pulling, it was required to operate an ever-widening range of labour-saving appliances as soon, following the removal of wartime restrictions, as these became readily available.

(c) There was, therefore, a great urge among large-scale farmers to replace existing tractors by more modern ones; and there were readily available large numbers of less modern ones to be disposed of. Today, largely as a result of this, even the smallest of U.K. farms use mechanical power almost exclusively.

9. In the foreseeable future this process of mechanization which is self-inspired downwards cannot be expected to happen at all similarly in less-developed areas. Relatively to the total area of farmland, the numbers of tractors and tractor implements in large-scale farming will be far too small; while the numbers of very small farms will be far too great. Moreover, as a result of the rapid depreciation already mentioned, the useful life of machines will be so much shorter that second-hand ones which are still truly serviceable will be something of a rarity. It follows that if, in line with what has generally been the rule elsewhere, less-developed countries confine their encouragement of mechanization to farms and other enterprises large enough to accept it as it stands, and leave further extension to natural economic development, the impact of the process on overall food and fibre production, and on general standards of living, will for a long time to come be very small indeed.

10. The circumstances which lead to high operating costs are to be found almost inevitably wherever mechanical equipment is newly introduced: in state-controlled land-use mechanization and private farm mechanization alike. In the past they, too, have existed in greater or lesser degree wherever farm mechanization is now well advanced. Indeed, as recently as twenty years ago, when wartime food production efforts suddenly brought tractorised equipment to grassland areas unaccustomed even to horse-drawn ploughs, they were something of an embarrassment in the United Kingdom. They are the result simply of lack of experience and "machinery-mindedness"; and can be overcome only by education and practical training at all levels from tractor drivers and mechanics upwards.

11. In many less-developed countries there are now reasonable facilities for training drivers and mechanics; but there is at the same time a high wastage of trained and semi-trained men to road transport and other non-agricultural occupations. There are also increasing facilities, both in local colleges and through overseas studentships, for training men at or near graduate level; but most of the men so trained go afterwards to administrative posts too far removed from the everyday problems of farming. Nor is this always the fault of the authorities responsible for directing them: on one recent occasion a Prime Minister addressing a batch of agricultural students about to go overseas for training was heard to warn them not to come back feeling too "educated" to work in the field.

12. Between these extremes there is a wide gap. Hardly anywhere in these areas is there anything like an adequate supply of what, in army parlance, may be called the non-commissioned officers: men practical enough to improve machinery usage and management by direct example; and yet knowledgeable enough to influence decisions on such matters as choice of equipment and organization. To make provision for filling this gap by specific training is not at all easy: most of the essential attributes can be developed only through practical experience.

13. Complaints about the service and repair facilities offered by agents and distributors in less-developed areas are often well-founded. Almost everywhere service standards fall well short of those to which farmers in more highly mechanized areas are accustomed. But everything necessary for giving good service - representatives and mechanics, their transport and workshop equipment, along with the costs of maintaining adequate stocks of spare parts - has to be paid for out of whatever profits can be earned by selling machines. And so long as relatively few machines are scattered over relatively large areas; while, for one reason or another, the incidence of breakdowns is higher than it should be; the costs of giving prompt attention to customers' difficulties will tend to be prohibitive. Everyone will have heard stories of service vans and mechanics being sent a hundred miles to deal with emergencies which turn out to be no more serious than a choked jet or water in the fuel. At least in principle, most of them are true. Given the most competent agents imaginable, the effectiveness of service arrangements will still be in some kind of proportion to the density of machines on the ground.

14. The conclusion to be drawn from the service angle - that only more mechanization will lead to better mechanization - also has a bearing on the other 'usage' difficulties that have been mentioned. In an atmosphere of expanding mechanization all of them will tend to be alleviated. Tractor drivers and mechanics will see better prospects of advancement, and will be less likely to leave agriculture for other occupations. Men trained at graduate level will have more sense of purpose, and be more conscious of the opportunity to make good use of their talents outside purely administrative posts. Many more of what have been called the non-commissioned officers will emerge automatically. Above all, everyone concerned will have far greater opportunities to learn by example. Over the years British farmers have learnt more by what is commonly called "looking over the hedge" than by any other means.

15. To discuss social or political questions, or even to advocate widespread agricultural mechanization, is outside the scope of this paper. It does, however, seem certain that, among other ways of overcoming these present difficulties, less-developed countries will look increasingly to the use of mechanical power in farming. They must, therefore, seek means to encourage mechanization in at least this simple sense on holdings smaller, and perhaps very much smaller, than those now commonly involved. In India, which is chosen as example only because statistics [1.] are readily available, only one third of all farm land is in holdings of 25 acres and over, while more than a third is in holdings of under 5 acres. Later in this paper what may be called organizational methods of extending mechanization; including such measures as the setting-up of contracting agencies, or the encouragement of co-operative machinery usage; will be discussed. In the meantime another possibility, the provision of less-costly equipment, must be considered.

16. At present practically all the equipment of mechanization comes from manufacturing countries in Europe and America; and, from the standpoint of most less-developed countries, it would be unrealistic to suggest that this can change at all markedly in the foreseeable future. But none of the manufacturing countries, nor yet any individual manufacturer, has so far designed or developed ordinary farm tractors specifically for export. Subject only to quite minor modifications, the design of all those they send overseas is conditioned by the requirements of their home markets.

(a) But in these same countries the appliances of mechanization have had continually to be extended and elaborated to keep pace with the consequences of industrialisation. New or expanding industries have drawn more and more workers from the countryside; higher wages and living standards in the towns have brought ever-increasing demands from those who still work on the land. To reduce labour requirements to a minimum in every aspect of farming has become a controlling factor in the development of all farm machines.

(b) As a result of this, present-day tractors have been a great deal elaborated even by comparison with those of, say, twenty years ago. Instead of 3 or 4 gears, they now have anything from 6 to 10; features like steering brakes, adjustable wheeltracks, live power take-offs and differential locks which, if available at all, used to be optional extras have become standard equipment. On top of all this, but for no very logical reason, ever more elaborate styling has come into fashion. Models equivalent to those with which countries whose methods are now well advanced started farm mechanization are no longer manufactured.

17. Apart from styling, which is of no great practical use to anyone, most of the elaborations just mentioned are concerned in one way or another with saving manual labour: that is, with an aspect of mechanization with which, at the outset, less-developed areas will not be greatly concerned. In present circumstances most potential tractor users in these areas could manage without them, and perhaps would willingly do so if they could save money thereby. Against this, manufacturers would no doubt argue that in highly-automated mass-production - without which the tractors would be still more costly - little, if any, saving of money results from leaving things out. Against this in turn, the present writer would be inclined

(1.) India 1960. Publications Division, Government of India.

to re-argue that every elaboration makes the tractor more difficult to understand and maintain in good order; and that, even if their omission saves no money, most potential users in less-developed countries would be better off without them.

18. To look at this question more rationally: at present perhaps nine-tenths of all tractor sales are made in countries with highly sophisticated farming systems. Quite rightly, therefore, from the manufacturers' viewpoint, design and production policies are dictated by the requirements of these countries. On the other hand, it is quite certain that if the essential requirements of less-developed areas were studied, with no reference at all to more sophisticated requirements elsewhere, one outcome would be a specification for a potentially simpler and cheaper tractor.

19. The one reason why this has not been done; or, if it has been done, why nothing practical has resulted; is that the potential 'live' market has never looked large enough to justify the very high investment in completely new tooling that would be needed. Yet, undeniably, if some compromise between all the conflicting viewpoints could be reached, the potential market is a very substantial one.

(a) In a study of agricultural mechanization in the Indian economy,[2] for example, Behr suggests that farms of 25 acres and over are large enough to permit efficient capitalization including especially the individual purchase of tractors. He considers, too, that in most cases the farmers concerned would actually have money enough. However, if only half of them were in this position, but there were no other barriers, there would be an immediate outlet for more than a million and a quarter tractors.

(b) How far India is at all representative of less-developed areas in general is open to question. Elsewhere, in relation to area, corresponding estimates might be less optimistic. Nevertheless, the estimate just given for India alone would absorb Britain's total tractor exports for a period of six or seven years; and, at present, Britain is the world's largest exporter. It must, however, be remembered that British farmers with no more than 25 acres would be unlikely to start off by buying new tractors: as indicated earlier, reconditioned second-hand ones would be the more general rule. Nor, so long as present specifications and prices persist, is it likely that 25-acre farmers in India will do so.

20. At this point it should perhaps be mentioned that in Britain the supply of second-hand tractors filtering down from large farms already exceeds the demand from smaller ones. The surplus, amounting to three or four thousand units a year, is exported. So far as is known, none of these tractors yet go to less-developed countries: the main outlets are in near-by countries in which mechanization is already well-advanced, but in which tractor populations are still rising. In time much larger surpluses of still-serviceable tractors may become available from other countries beside Britain. In theory, therefore, this may represent another possible source of cheaper power units for less-developed areas.

(2.) Behr, A.P.B.G. The place of agricultural mechanization in the Indian economy. Proceedings of the Institution of Agricultural Engineers, London. Vol. 17, No.1 (1961).

(a) At present, and for two reasons, second-hand tractors can be exported in comparatively casual fashion: in the receiving countries all the services necessary to support mechanization are well-established; while the numbers concerned represent only a small proportionate addition to the existing tractor population. Not all the tractors go through regular distribution channels; some are sold in "off-the-farm" condition, the customer taking responsibility for any reconditioning that may be needed. Exports to less-developed countries would obviously need to be backed by some more elaborate organization.

21. The kind of tractor that the writer has in mind, as the possible outcome of new thinking on the lines indicated in paras. 17-20, is not something essentially new. Most probably the outcome would be a tractor not very different from one or other of those that were current thirty or forty years ago. Subject only to the difficulty of getting manufacturers to look at the situation seriously, and without too much regard for their present more sophisticated markets, it is, therefore, a quite practicable proposition. At the same time, even if the resulting selling price was no more than half that of the tractors current today, it would still be too high to permit individual ownership by the majority of peasant land-holders. Accordingly, and recalling the circumstances outlined in paras. 4-6, a still less ambitious approach may be considered. To overcome the limitations then outlined would need nothing more in principle than the mechanical equivalent of a rather stronger, faster-working, bullock team. Indeed, if such an equivalent was capable of pulling only the same indigenous implement as a pair of bullocks do now; but could at the same time carry the man using it, and keep moving at, say, 2½ miles an hour; it would have more than twice their useful work output. A very small and simple power unit, somewhat in line with this conception, has recently been developed at the National Institute of Agricultural Engineering; and is to be described in another of the papers 3. to be read at this Conference.

22. Whether a very small and simple tractor would, in fact, prove to be practicable has been discussed by a number of different authorities over the years. In particular, Hawkins, 4. whose wide first-hand experience lies mainly in areas with which the present writer is unfamiliar, considers that it would be found to be impracticable because, as the result of modifications during its early trials, it would inevitably grow into something which would be no more than a smaller version of the standard models now available. In order to pull even a single-furrow plough in hard land it would need to be able to exert a drawbar pull of at least 1,000 lb.; and should be capable of doing this at altitudes up to 5,000 ft. It must be robust enough to withstand rough usage on only partly-cleared land; it will need to have a belt pulley to provide power for pumping, grinding and threshing; and so on. There is some justice in these objections: throughout tractor history there has been a tendency for small tractors to grow larger so as to widen their potential market. There are, nevertheless, vast areas not much above sea level, and unencumbered by tree-stumps or boulders, waiting for a cheap enough means of mechanical cultivation. Nor is there everywhere the need to pull a turn-furrow plough.

(3.) Cashmore, W.H. The development of agricultural equipment for use in the less-developed areas.

(4). Hawkins, J.C. From man-power to machines. World Crops, Vol.13, Nos. 8 & 9 (1961).

23. Arising from the last point, one very obvious cause of high operating costs is that practically all the implements which accompany tractors to less-developed areas are quite strange to those who use them. A familiar example, which must already have cost large sums in repair costs, is the multi-furrow plough which is turned around at the end of the field without being lifted out of work. This kind of mis-use is very difficult to eradicate. If tractor implements followed the pattern of indigenous ones more closely a great deal of misunderstanding, and need for re-education, would be avoided. So far as is known, 'tractorised' indigenous implements do not exist anywhere; while instances in which there is firm evidence that agronomic advantages result from using non-indigenous ones are remarkably few. There are, on the other hand, some notable exceptions to this; including the method of tied-ridge cultivation, for marginal land in semi-arid regions, with which Hawkins himself has been largely concerned.[5.] This certainly could not easily be applied without something very close to a conventional tractor.

24. Finally, it would be wrong to close this discussion of the possibility of providing less-costly equipment without some mention of two-wheeled 'walking' tractors. They are of the same order of cost as the still-hypothetical very small 'riding' tractors would be; and are already available commercially. Also, in modest numbers, they are already exported, mainly for small-scale paddy cultivation, to less-developed areas. But they are essentially garden cultivators designed in the first instance for intensive market gardening in temperate climates, or for use in private gardens in urban areas; and it is questionable whether, if the needs of less-developed areas had been the sole consideration, they would have come into existence at all. To handle a two-wheeled tractor throughout a full day's work would tax the strength of a fit, well-fed man anywhere; and would probably be out of the question for those who are less well-fed, and work in tropical or sub-tropical climates. This kind of equipment is to be regarded as a possibly useful adjunct to mechanization in less-developed areas, rather than as an effective means of extending it.

25. No method of providing less-costly equipment can come to fruition within a period of several years; while of those that have been mentioned neither the organised supply of second-hand tractors, nor the production of simpler versions of conventional tractors, would by itself do anything to help very small farms. Whether the third method, the development of simple bullock equivalents, is practicable at all is problematical. For some time to come, therefore, and perhaps for all time, what have been called organisational methods of bringing mechanical power to the aid of very small-scale farming are likely to be of more general consequence. The range of activities that this description might cover is a very wide one, ranging from Government organisations with large fleets of equipment to village enterprises perhaps with only a single tractor. Of the schemes of one kind or another that have operated so far, some have failed altogether; while some others, at least in terms of sheer physical accomplishment, have been highly successful. But, if all overhead costs are included few, if any, have been economically successful in the sense that the work has been done at a cost which peasant farmers could afford to re-pay in full. This, nevertheless, must be the ultimate aim.

(5.) Cashmore, W.H.; Hawkins, J.C. Tillage Equipment and Soil Conservation. Proceedings of the Institution of Agricultural Engineers, London. Vol.13, No.1 (1957).

26. If, while seeking to make use of mechanical power, very small farms are to preserve their independence - i.e. to be able to grow what they like, when they like - they must either hire tractor services or share them. Even then, because the equipment will be working in small and perhaps badly-shaped fields, and will have to move frequently from one field to another, work output will be lower and operating costs higher than they would otherwise be. On the other hand, if some measure of independence can be given up, there are the much wider possibilities that would arise from regrouping farms, field, or even crop rotations. To deal with these at all fully would involve social and political questions which the writer is not competent to discuss. Mention of one or two instances in which something of the kind has been done will, however, be useful.

27. Of all the ventures in less-developed countries, in which mechanization has played an essential part, the most outstandingly successful has been the now well-known Sudan Gezira Scheme.[6] This started with the building of a dam, and the constructors of all the works necessary for a very large-scale system of canal irrigation. This by itself meant introducing some kind of order into an area in which farming, up till then, had had no pattern at all. In fact the re-patterning went well beyond what was necessary from the irrigation standpoint alone: the whole system of land-tenure was modified so as to allow all basic tillage to be mechanized.

(a) All the land was compulsorarily purchased; the original owners being given preference in the subsequent allotment of tenancies. Within an overall pattern, which need not be described here, the land was then divided into "fields" of the order of a hundred acres, which rotated annually between cotton, the main cash crop; food crops for men and animals; and fallow. Tenancies are on an annual basis: each family holding consisting of so much land in a cotton block and so much in a food-crop block. With this arrangement all major operations, like ploughing or special methods of weed control, can be done with large-scale equipment at a price which individual cultivators can afford. The area concerned on any one occasion is always large enough.

(b) The Gezira Scheme started under a Colonial Administration; and, in this and other respects, the circumstances which have favoured its success may not now exist anywhere else. Nevertheless, two major results of the original scheme should be mentioned. The first is that although, at the outset and for years afterwards, the Scheme depended very largely on the services of expatriate staff, it now operates just as smoothly, and has recently been extended quite considerably, with an entirely Sudanese personnel. The second is, that as a direct outcome of the Scheme, most of the tenants have become highly prosperous. In many cases they and their families are now too prosperous willingly to go cotton-picking; so that labour shortages are arising.

28. Another instance, already briefly mentioned, is the reclamation of weed-infested land in India by the Central Tractor Organization. This started soon after the war with the gift of about 300 heavy crawler tractors left behind by the American Army. At that time, and even in countries

(6.) Ferguson, H. The Gezira Scheme in the Anglo-Egyptian Sudan. World Crops. Vol.4, Nos. 1, 2 & 3 (1952).

much nearer possible sources of supply, spare parts of any kind were difficult to procure; and, through the need to set up workshops for making them, the Scheme had to bear a heavy burden of overheads almost from the outset. The work was highly seasonal: effective weed-killing being possible only during about six months each year. At first, efforts were made to extend the tractors' annual period of activity by using them also for land clearing, but this cost too much in machinery repairs. The equipment as a whole was, of course, too heavy to be used in anything like ordinary farm operations during the off-season.

(a) The work was organized on a grand scale with teams of 8 or 10 heavy tractors ploughing areas of several thousand acres in one piece. The land, although derelict, was still owned by individual cultivators in the familiar pattern of odd bits and pieces. Compulsory powers of some kind had, therefore, to be used to provide large enough reclamation areas. Immediately afterwards, however, the land reverted to its original owners.

(b) No single operation can be expected to eradicate weeds like Kans grass completely: some viable fragments will remain and, from these, after three or four years, the weeds, too deeply-rooted to be controlled by animal-drawn tools, will begin to reappear. For this reason there arose the need for follow-up tractor operations, generally done on smaller scale by more localised Government agencies. But the scale was still far too large for the ploughing of one- or two-acre fields to be practicable. It was, therefore, necessary to persuade individual cultivators, some of whose own fields might not yet be badly infested, to fall in with their neighbours, so as to provide areas large enough to work in.

29. Although rather far removed from our main theme, these two instances illustrate points which have much wider application. Wherever, perhaps as a consequence of land-use mechanization, completely new areas become available for cultivation, layout on something akin to Gezira lines should be practicable, and would greatly facilitate mechanization. Moreover, this would be true whether or not irrigation was involved, and even if the area of land to be dealt with was very much smaller. Indeed, given only willingness to co-operate over land re-distribution, much the same principles might be applied to areas of only a few hundred acres. Alongside this, the C.T.O. activities illustrate the kind of way in which land-use mechanization measures tend to throw up a need for smaller-scale mechanization afterwards. This instance also raises the question of whether, even in a job of this magnitude, a smaller-scale approach with less elaborate equipment might not be ultimately more rewarding. As things actually happened both the equipment and the initial scale of operations were dictated by circumstances - i.e. a legacy of several hundred heavy crawler tractors. Otherwise, the job could almost certainly have been done with something simpler, e.g. with wheeled or half-track tractors pulling only single-furrow ploughs. In this case it is likely, but not at all certain, that the first ploughing itself would have cost more. But against this, it would have been far easier to utilize the equipment more fully; follow-up cultivations would have been easier to organize; while the broad educational results would have been far greater. Large crawler tractors are so far beyond the most optimistic aspirations of a small farmer that, even where used on his own land, they teach him little or nothing about mechanization.

30. In the writer's view, this last point is a most important one. Almost universally with mechanization ventures in less-developed countries the degree of success or failure is determined very largely by whether or not enough trained or experienced men of the right calibre are available. Particularly where small-scale mechanization is in question, conventional training facilities like those already mentioned in para. 11, are not a complete answer. There will rarely be enough of them to reach individual small farmers; and there are qualities to be developed which they hardly touch. For this reason, wherever there were two alternative 'mechanization schemes' to choose from, the writer would prefer whichever was more likely to develop, or bring out, the abilities required. Just what is meant by 'men of the right calibre' is difficult to define, but actual examples can be given.

(a) In one instance, in which ploughs were being wrecked by turning without lifting, the man in charge was quite aware of what was happening; and said that he had often enough exhorted his tractor drivers about it. What he had never done, or thought of doing, was to go into the field, turn a driver off his tractor, and show him there and then how the job ought to be done.

(b) In another instance, and in another country, what was described as a successful co-operative scheme was inspected. Two tractors and a modest complement of tillage tools had been put at the disposal of a small village along with a man to take charge of them. Most of the equipment was on its last legs; but this was mainly because there were no near-by facilities for anything like thorough overhaul. The man in charge appeared to be technically competent, and day-to-day maintenance seemed to have been reasonably good. In effect, therefore, the equipment had worn itself out more or less legitimately. But as closer enquiry showed, it had worn itself out almost entirely in the service of the local landowner who himself farmed a few hundred acres: the villagers had hardly had sight of it.

(c) In yet another instance, four government-owned crawler tractors with multi-furrow ploughs were engaged in ploughing, all in the same field. Each driver had made his own 'start' quite independently of the others; and no two of them were anything like parallel. The final outcome was chaotic. When criticised about this, the man responsible for the work - in an office some miles away - said that the four men concerned were all 'graded' tractor drivers, and all equal, so they should have sorted things out for themselves.

31. These examples have been chosen from others that might have been given because they illustrate the qualities like integrity, willingness to demonstrate by example, and ability to organize field-work, which most conventional training fails to develop. All the men concerned had actually been trained at either graduate or lower level. The examples also illustrate the need, already mentioned, for non-commissioned officers. Training of a rather different kind is now being given, under the auspices of the Central Treaty Organization at a centre in Iran.[7] This has been operating only since the latter part of 1961, so it is too early to judge how far it will provide what has been lacking hitherto. However, since the writer was one of those responsible, after a lengthy tour of the Region, for recommending that the Centre should be established, the ideas behind it can be outlined.

(7.) Agricultural Machinery and Soil Conservation. Training Centre, Karaj, Iran.

32. The broad intention was to train men who could afterwards be competent to serve as 'project leaders' in any kind of activity which involved the use of tractors and associated farm machines. Alongside more general tractor usage, soil conservation was to be given particular attention because often enough soil conservation measures are the first kind of activity to bring tractor equipment into particular areas. Students would be eligible for entry only if they had already been trained at graduate level in agriculture or engineering. The course, including a leave period, was to last a year; but new entries were to be taken every six months so that at any given time there would be junior and senior classes under instruction. Against a background of appropriate theoretical teaching, practical instruction was to be directed mainly in four directions: everyday care and maintenance of equipment; adjustment and setting of implements in the field; layout and carrying out of field-work; and the organization of all these things together in field projects.

(a) The main novelty of the scheme lies in the way in which practical instruction was to be given. There were to be tractors, implements and land enough for each junior student to engage in actual tractor operation for some hours every day. At any given time each tractor, along with an associated implement, would be definitely assigned to a particular student who would be entirely responsible for looking after and using them. In the early stages of training, things like tractor servicing or the inspection of implements after work were to be taught as a regular 'drill': students being required to do them as a matter of routine every morning and evening whether they were actually necessary or not.

(b) Another unusual feature was that there was to be a bare minimum of instructional staff: perhaps, apart from two or three lecturers in background subjects, only one man in general charge of all maintenance and repairs, and another in charge of all field-work. Detailed instruction was to be given as far as possible by the Senior Class largely on a man-to-man basis. There was also to be a bare minimum of labourers and mechanics: as far as possible all actual work on the land, or in the workshop, was to be done by the students themselves.

(c) In addition to acting as part-time instructors, the senior students were themselves to receive more advanced training, e.g. in land surveying, the planning and lay-out of soil conservation measures, and in organizational methods. Nor was the reason for using them as part-time man-to-man instructors an economic one. The aim was to turn out men so well drilled in good machinery habits that they could not afterwards tolerate bad ones without taking a direct hand to put things right.

33. After many digressions we come now to the real core of the problem: to find means to bring mechanical power to the aid of small farms as and where they exist at present. In broad terms, the answer has been given already: small farmers must either hire the services of tractors or share them. The subject has been widely discussed over the years, and is among those dealt with, from two quite different viewpoints, in papers already quoted.[2,4] From all discussions alike three main possibilities emerge: the establishment of government contracting services; the encouragement of 'village' contractors; and joint machinery ownership by groups of farmers.

34. By government contracting services is meant essentially services which are administered from a central headquarters and which operate over a fairly wide area: e.g. over a radius of, say, 15 miles or more. They are in fact called 'government' services only because no purely commercial agency has yet undertaken anything of the kind in less-developed areas. Reference to several existing schemes is made, along with a great deal of useful comment, in a symposium on mechanical cultivation in Uganda. 8.

(a) No government contracting service has ever yet proved to be economically viable on its own account; nor is this wholly, or even mainly, because government activities inevitably incur high overhead costs. In most of the instances in which factual costs have been published overheads of this kind have been omitted: even so, the cost of the work done has always been more than most small-scale farmers could afford. The real reason why contract services are uneconomic is that the individual jobs to be done are too small and too far apart: men and equipment spend too much time travelling, and too little at work. In Uganda, for this reason, it is suggested that a farmer with only 2 acres to be ploughed, should be charged twice as much per acre as one with 20 acres.

(b) Efforts to overcome this difficulty by more rational work planning very often defeat themselves. For example, when the work of a particular output is being arranged, within a total tour of, say, 20 miles, there will be points at which several individual jobs are within half-a-mile or so. It is then good planning to arrange that, when the tractor reaches a point like this, it stays there to complete all the near-at-hand work before moving on. But very often the result will be more urgent work, which happens to lie farther on in the tour, will be delayed. Again in Uganda, dissatisfaction arising in this way is a main reason why many first-year customers do not re-engage contracting services in the subsequent year.

(c) One possible way out of this dilemma is Group Contracting. This means roughly that unless, in a given district, there are enough interested farmers to provide a worth-while area of work, the tractor will not go there at all; and that, wherever it does go, the work will be done for, and charged to, the whole group of farmers. But wherever group contracting is practicable, circumstances would favour one or other alternative to government contracting equally well.

35. Against this, the alternative of encouraging village contractors is an attractive one. Here the broad idea is that one man, perhaps himself a small farmer, would buy a simple set of equipment to undertake, on purely commercial lines, work for his neighbours. Overhead costs, apart from interest and depreciation, would be at a minimum; the work would lie close at hand; and, because the man's own financial well-being would be at stake, the equipment would be well cared-for.

(8.) Symposium on Mechanical Cultivation in Uganda. Department of Agriculture, Uganda (1960).

(a) Wherever village contractors establish themselves, their contribution to the solution of the whole problem will be most valuable. But of those who favour this alternative few, if any, seem to think that one-man contractors will emerge spontaneously. They envisage, in fact, that some agency, perhaps a local government authority, will select a suitable man; train him for his job; provide credit facilities to help with the purchase of equipment; and, at least until the cost of the equipment has been fully repaid, supervise his activities. The one likely shortcoming of the village contractor is that, with the need to make the venture a commercial success always in mind, he would tend to neglect very small-scale holdings in favour of larger ones.

36. The one commonly-expressed objection to the third alternative, joint machinery ownership, is that farmers are notoriously bad co-operators. Against this it could be argued, that in most less-developed countries, villagers and other rural dwellers are already more dependent on one another than they commonly are elsewhere. It could also be argued that practically everything apart from mechanization that could or will be done to raise living standards in rural areas will have to be organized, in one way or another, on a community basis. In some areas at least, therefore, circumstances more favourable to joint machinery ownership are likely to arise automatically.

37. Granted that the only form of government contracting likely to succeed is group contracting; and also that to avoid chaos in joint machinery ownership, there must be one man, or one man per tractor, to operate and service the equipment; the practical differences between these three approaches are probably not as great as they may appear. With all of them alike there must be (1) a reasonably compact area to be served; (2) equipment which is adequate, but not overelaborate, for the purpose; and (3) skilled men at the rate of at least one per tractor. Also, somewhere in the background, there must be adequate facilities for repairs and spare parts. If these facilities are lacking, or if the men operating the equipment are not good enough for this job, the scheme will fail regardless of who nominally employs them or who plans their work. In any case, hardly anywhere is there a firm enough basis of actual experience to guide choice between one scheme and another. The most that anyone could recommend with confidence would be the setting-up of pilot schemes.

38. Behind the whole of this paper lie three firm convictions: that low-level farm mechanization will be necessary, sooner or later, in most less-developed countries; that, in accomplishing this, training in its broadest sense will be by far the most important issue; and that the need for simpler and less-costly equipment is not only a very real one, but is one which, given only a sufficient interest by manufacturers, could actually be met. In the light of these convictions, and of the preceding paragraph, it is proposed to end by indicating lines along which practical training and a multi-purpose pilot scheme might be combined in a way which might also attract the direct interest of manufacturers. To avoid repetition it is assumed that the kind of practical training to be given would be similar to that already described at some length in paras. 31 to 32 (c).

(a) Necessary requirements in any training venture are students and instructors; facilities for housing and feeding them; and training equipment like tractors and what goes with them. In what is now proposed all these would be located in an area of small-scale farming, reasonably well suited to low-level mechanization; while practical field training would be associated, as closely as possible, with the provision of contract services for neighbouring farmers or groups of farmers. Once they were capable of driving a tractor junior students, at first with a senior student beside them, would get further training and experience while actually doing a real job on a farmer's own land.

(b) An unusual feature of the C.E.N.T.O. training scheme, not so far mentioned, is that manufacturers took a hand in establishing it. British manufacturers, jointly through their Trade Association, contributed free of charge tractors and other equipment to a value of around £50,000 together with an estimated twelve months' supply of fast-moving spare parts. They are also actively represented on the governing body. In what is now proposed one manufacturer, whether from Britain or elsewhere, might be induced to co-operate rather differently by (1) providing equipment on reasonable credit terms; (2) ensuring, through a local distributor, adequate on-the-spot service and spares facilities; (3) providing, by secondment, two men of ability as Chief Instructors; and (4) keeping in close touch with the progress of the venture through visiting representatives.

(c) In theory, to choose one manufacturer rather than another might be embarrassing. In practice, it need be no more difficult than choosing one rather than another to buy from. If several different manufacturers were equally ready to co-operate, there might be several schemes in different areas.

39. There is no need to go into great detail here. But once established on flexible lines a venture on these lines could accommodate trainees at all levels: project leaders, non-commissioned officers and drivers; each for an appropriate training period. It could also create within itself pilot schemes of any kind. At any time, groups of students and equipment could be temporarily organized so as to operate as group contractors, as one-man contractors, or as the nucleus of a farmers' machinery-sharing scheme. With manufacturers' interests closely and actively engaged, it might bring about much greater appreciation of the needs of small farmers in less-developed countries as, and where, they actually exist. Starting tentatively in a small way, such a venture might find that it had mechanized the whole area; and must start again elsewhere.

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ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: D

United Kingdom

DIFFICULTIES OF MECHANIZATION IN LESS-DEVELOPED AREAS

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DIFFICULTIES OF MECHANIZATION IN LESS-DEVELOPED AREAS

by S.J. Wright, M.A.
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SUMMARY

Three aspects of agricultural mechanization are considered: land-use mechanization, which is likely to involve fleets of heavy equipment; ordinary farm mechanization, which is limited to farms or enterprises large enough to afford ordinary equipment; and mechanization in the much wider sense of whatever can be done to bring mechanical aids to the service of the very small peasant farms which, in most less-developed areas, will account for the greater part of all farm land.

In these areas, where labour is commonly plentiful, mechanization can be justified, if at all, only by higher production of food or fibre. Opportunities to do this by winning additional farm land are limited. Almost everywhere, far greater opportunities will lie in overcoming whatever factors may limit the productivity of the land already being farmed. One factor, which leads to poor crops through untimely sowing or inadequate weed control, is the very limited work output of the peasant's pair of draught animals. They cannot pull very much; they are slow-moving; and they need to stop frequently for rest or watering. In many cases, to overcome this limitation would need only a very primitive tractor.

Against this background, there is one all-embracing difficulty: that in less-developed areas mechanization costs too much. On the one hand, there are the relatively high capital costs of equipment which limit individual ownership to a very small proportion of farmers. On the other, there are the high operating costs which arise from inexperienced usage, high incidence of breakdowns and repairs, and too-rapid depreciation.

Difficulties over capital costs are accentuated by the fact that, mainly to meet labour-saving requirements in their countries of origin, the simplest of modern tractors has been a great deal elaborated: not only by comparison with the very simple requirements of small-scale peasant farmers; but even by comparison with the tractors which were commonly used in now more-developed countries thirty years ago. If simpler, and potentially less-costly, tractors like these were still available many more farmers in less-developed areas would be able to afford to provide themselves with mechanical power. They have gone out of production only because in the more-sophisticated markets in which nine-tenths of all tractors are sold, they are no longer needed. If manufacturers, or even one manufacturer, could be convinced that the

'live' market in less-developed countries is large enough, they could be reintroduced.

But even if less-costly equipment can be made available in this way, mechanization which is spread widely enough to raise overall living standards appreciably can only be accomplished by organisational means: by the provision of Government contract services; by the encouragement of village contractors; or by the development of schemes in which groups of farmers share the services of jointly-owned equipment.

In general, the circumstances which lead to high operating costs can be overcome only by education and practical training at all levels from graduates to tractor drivers; even so, some of the required qualities can only be developed through real experience. In order to provide enough men of the right calibre not only to overcome present mechanical difficulties, but also to bring organisational methods of extending mechanization to fruition, something more than an extension of conventional training schemes will be needed.

Finally, a type of scheme in which both practical and higher training, and pilot experiments in extended mechanization, might be combined is outlined. This is based on an existing training scheme, which is described in some detail; but would be located in a district of small-scale farming which, in the long run, it would aim actually to mechanise. If, as in the existing scheme, the direct interest of manufacturers could be enlisted, one outcome might be a fuller realisation of the needs of small-scale farmers in less-developed areas.

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ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.6.1

Czechoslovakia

NEW METHODS OF TEXTILE TECHNOLOGY

By Joseph HOUSKA,
Ministry of Consumer Goods Industry,
Czechoslovak Socialist Republic

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NEW METHODS OF TEXTILE TECHNOLOGY

by Joseph Houska, Ministry of Consumer Goods Industry
Czechoslovak Socialist Republic.

1. In Czechoslovakia, the shuttleless looms are now developped as jet looms, i.e. looms carrying the weft taken off from the large shape cheese and inserting it into the shed by means of a water jet (in the case of looms used for the manufacture of synthetic fabrics) or of an air streem (in the case of the remaining fabrics).

2. The pick based on this principle exhibite, besides the current advantages of the shuttleless systems further considerable advantages over the remaining shuttleless systems in particular:

3. The weft can be accelerated inside the shed and this feature makes it possible to attain high mean picking velocities even in the case of small loom widths (the long starting and braking paths on the sides of the shed are not required).

4. There is no risk of weaving- in the weft carrier and there is no need to insert, between the picking cycle and the cycle of beating up the weft, another cycle for the check up of the arrival of the weft carrier, the latter entailing time-losses in the case of the other picking methods.

5. The reversion of the weft carriers is eliminated and the design of the loom may be simple indeed (the existing jet looms having smaller numbers of parts than the automatic shuttle looms).

6. The noise due to the operation is out down to the lowest degree of all the available weaving methods.

a) Hydraulic jet looms:

These looms are designed for manufacturing of plain weaves, four- and eight-end fabrics. They are particularly suitable for the manufacture of light and medium-heavy fabrics made from synthetic yarns.

i) Principal technical characteristics: Effective reed space-105 cm; working revolutions (350,400 rev.min.; input of electric motor- 0,8 kW; weigh of machine-1100 kg; overall width of machine-1,800 mm; depth of machine - 1,300 mm; maximum height of mach'ne 1.400 mm; number of ends: 8-120 picks/cm.

ii) The results obtained in plants equipped with current automatic shuttle looms and the results achieved in plants equipped with the type H 105 B hydraulic jet looms are the following:

Index	Weaving mill equipped with automatic shuttle looms	H 105 B looms
Manpower required for the production of 100 metres/year	0,097 workers	0,067 workers
index	100	69
Ground-plan area of plant required for the production of 1000 metres/year total	2,19 sq.metres	1,0 sq.metres
index	100	46
Capital expenditure of building a yearly production capacity of 1000 metres (4000 hours per year)	8140 Cz.crowns	5810 Cz.crowns
index	100	71,3
Breakdown:		
Machinery	6390 Cz.crowns	4830 Cz.crowns
Buildings	1750 Cz.crowns	980 Cz.crowns
Total costs of production of 1000 metres of fabrics	5481 Cz.crowns	4522 Cz.crowns
index	100	82,6
Breakdown:	Cz.crowns	
Wages	1465,90	886,10
Auxillary materials	68,50	43,10
Heating and power	158,20	84,90
Maintenance	238,70	158,50
Depreciation	611,70	431,10

The above results have been obtained with the average number of 44 filling threads per 1 centimetre and while processing rather inferior materials, with an average of 350 rev./min. of the loom and the average efficiency of the loom of 80,67 p.c. Further tests have demonstrated that when processiong high-grade synthetic materials there is no difficulty in attaining an efficiency of 92 p.c. at 400 rev/min.

iii) The jet looms are destined for the manufacture of a wide assortment and that from the finest fabrics in minifil with number of ends in warp 142 and 120 pics /cm up to filter cloths about 245 g per m^2 from 200 den. Fibres used in warp and 2 x 200 den fibres for weft. The jet looms are especially destined for manufactoring of fabrics for outerwear, lingerie, shirts, coats, tent linen and weaves for technical purposes.

b) Pneumatic jet looms:

These looms are designated as type P 105 and destined for the manufacture of light and medium-heavy kinds of fabrics, especially of staple yarns from cotton, viscose, synthetic and mixtures as well as silk fabrics. They may be equipped for the weaving of plain weaves, on four-end wills, crepes and hopsacks Special accessories make it possible to weave even five-end fabrics.

i) Principal technical characteristics: Effective reed space - 105 cm; working revolutions - 350-400 rev/min; efficiency of machine depending on the processed material, on an average - 80 p.c. at 400 rev/min; input of 1,5 kW incl.pressure air-1kW; weight of machine - 847 kg; overall width of machine - 1750 mm; depth of machine - for 700 mm diameter of warp-beam-1410 mm; maximum height of machine - 1350 mm; number of ends: ß 5 - 120 picks/cm.

ii) For the sake of a comparison of the technical and economic parameters of jet looms with those of up-to date automatic shuttle looms as well as mechanical shuttle looms a comparison of three weaving mills has been worked out, each of the mills being equipped with four hundred looms of the indicated alternative types, and with low-speed machines in the preparatory shop for weaving, such machines requiring only a minimum maintenance and attendance.

The comparison is based on the production of grey cotton cloth (molino) for printing, reed space 83 cm, width of cloth 78 cm, numberof ends in warp and weft 21 threads per cm, material cotton yarn number metric 34, in warp and weft. A two-shift operation, yielding 4280 operating hours per year has been reckoned with.

The comparison yielded the following technical and economic index values:

Index	Unit	Weaving mill equipped with 400 looms		
		Mechanical looms	Automatic shuttle looms	P 105 jet looms
Revolutions of loom	rev/min	178	220	400
Efficiency of loom	p.c.	70	85	80
Production per 1 100cm/hr in metres	m	3,4	5,34	9,14
Yearly production of plant in metres	m	5,820.800	9,142.080	15,647.680
Index		63,67	100,-	171,16
Total number employed	persons	306	260	339
Yearly production per 1 employed person	m	19.022	35.162	46.158

Index	Unit	Weaving mill equipped with 400 looms		
		Mechanical looms	Automatic shuttle looms	P 105 jet looms
Index		55	100	131,3
Total floor space of plant (incl. auxiliary and similar floor space	sq.m.	5.441	7.552	7.933
Floor space required for annual production of 1 million metres	sq.m.	934	826	507
Index		113	100	61

The above values bear a clear testimony to the high level of the technical and economic indices of the jet looms. In addition no higher qualification or skill is expected of the weavers than in the case of standard automatic looms. The above values are obtained also in case simple machinery is retained in the preparatory workshop. A comparison covering weaving mills with preparatory workshops equipped with the most up-to-date automatic machinery would yield still more convincing results in favour of the jet looms.

II. Nonwoven fabrics:

7. Of particular interest is the new Czechoslovak textile technology of manufacturing fabrics by knitting-through a fleece from staple fibres. For fabrics produced by this method the name ARACHNE has recently become current. The manufacture of this kind of goods is based on knitting-through a fleece made from textile staple fibres. The method takes the place of weaving or knitting, elimitating at the same time, predominantly or entirely, the need for spinning textile staple raw materials. In this respect it should be noted that the production of ARACHNE fabrics is based, on an average to the extent of 80 p.c., on a fleece made from unspun textile materials, reinforced by knit-bond yarn. The latter is formed, according to the requirements of the particular product from various kinds of yarns or silk on the knitting-through machine ARACHNE, which has been invented and developed in Czechoslovakia, and also tested in the textile industry of this country.

a) Parameters of the ARACHNE knitting-through machine: Speed (r.p.m.) of machine - 270-500 r.p.m.; machine gauge-18,21 and 24 Sax.double; working width - 1.800 mm; number of guide bars - 1 or 2; guide cams (alternatives) - chain stitch, tricot, plain cord, diamind, weft; number of needles (latch and guide needles) per machine: 18 Sax double - 690; 21 Sax.double - 805; 24 Sax.double -

920; stitch density - from 20 to 100 per 10 cm; weight range of produced knitted-through fabrics - from 100 to 700 g/sq.m; machine efficiency - 65-85 p.c.; production per 8 hours - 150 - 450 metres.

Another developmental type of the knitting-through ARACHNE machine has reached an advanced stage of development and testing. It has been designed as a high-speed machine with 1000 rev/min, i.e. with a double maximum performance.

i) Functional parts of the knitting-through ARACHNE machine: Machine frame, mechine drive, needle motion, guide bars, warp let-off motion, web feed, outting motion, starting motion, fabric rolling device.

The working mechanism of the machine is formed by such parts as take an active part in producing the basic element of the knitted through fabric, such basic element being a course.

These parts are: The needles (incl.latches), the guide needles, the looking sinkers, and the knock over sinkers with driving mechanism.

ii)The formation of the basic element of the ARACHNE fabric, the course, may be divided into the following phases: Puncturing the fleece, lapping the thread, looking-in of the needles, loop sinking and knocking over, taking up. The forming of loops is analogous to the knitting on a warp knitting machine.

b) The preparation of the fleece for knitting-through on the ARACHNE machine in large scale production is done either on wool roller cards, or on cotton flat cards, or on special pneumatic webbers. The webs fed from the cards with fibres oriented predominantly in the longitudinal direction are folded, on the adapted Blamier lap apparatus into a fleece, the being now predominantly deposited in the transversal direction. The laps of these fleeces reinforced by pressing and having the required lengths are fed to the horizontal conveyer of the knitting-through machine. When producing heavy or combined ARACHNE fabrics it is possible to introduce two or three laps of fleece at a time. If required, also other covering or reinforcing fabrics or foils may be presented for knitting-through together with fleeces.

c) From the knitted-through ARACHNE fabrics of which on ARACHNE test plants alone 8 to 9 million square yards a year are produced in Czechoslovakia, diverse types of apparel are made for children, for young people, for men and women. Fabrics are produced for covering furniture and for decoration. Diverse ARACHNE fabrics are used in the shoemaking industrym in the manufacture of leather articles

and of artificial leathers. ARACHNE fabrics have also proved most effective as filtering fabrics. The research continues to develop and test further new types of ARACHNE fabrics for various purposes. The knitting-through techniques as well the techniques of the preparation of fibre fleeces are being modified and improved. The technology of the production of knitted-through fabrics is being extended and perfected, new types of products are formed by introducing new raw materials and their processing.

d) From the economic angle the described new method of production of fabrics is of interest, for it shortens, in a revolutionary manner, the hitherto known technological processes.

The output of the ARACHNE knitting.through machine is 6 to 10 times that of the automatic loom. In addition the spinning of fibres is eliminated. Compared to the classical production methods the Czechoslovak ARACHNE plants have already achieved an increase in the production per operator of up to 300 p.c. As soon as the perfected high-speed ARACHNE has been introduced of 400 to 500 p.c. of the labour productivity will have become realizable. It has been proved that the costs of the production of the ARACHNE method are reduced, in the item of direct wages, to 1/2 to1/3. The other cost items of the nature of overheads are also reduced substantially since the required floorspace, machinery and power as well as the amount of depreciation in the ARACHNE method are no more than 35 to 40 p.c. of the corresponding cost items of the production requiring the spinning and subsequent weaving or knitting of the raw material.

These advantageous operating features exert a favourable influence on the need for investment funds whereever new production capacities are to be built. While e.g. the building of a cotton-spinning, weaving and finishing mill for the yearly production of some 30 million square metres of average finished cotton fabrics requires an investment of 11.80 Cz.crowns per sq.metre of finished fabric, the building of a comparable ARACHNE capacity, equipped with a finishing shop which is equally expensive to built, requires an investment at the rate of mere 3.90 Cz.crowns per each projected sq.metre of the comparable ARACHNE production.

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Czechoslovak Socialist Republic.

NEW METHODS OF TEXTILE TECHNOLOGY
(Summary)

1. Weaving on hydraulic jet looms has been tested extensively in large-scale operation, On an extensive soale, an assortment has been manufactured ranging from the finer fabrics (number of ends 75 threads in warp and 75 threads in weft, and material with titre 15 den in both warp and weft) up to heavier sorts (nuber of ends 48 threads in warp and 46 threads in weft, from material with titre 2 x 40 den in warp and 2 x 120 den in weft). Also polyamide material, shrunk or unshrunk, has been used, rayon or staple material supplied by various manufacturers. This was, in the first place, the Czechoslovak Silon and Soviet Kapron, further the Swiss Nylon (manufacturer Nylsuisse viskose Emmenbrücke and Bodany-Feldmühle), the Belgian Nylon (manufacturer Fabelta-Tubize plant), the French Nylon (manufacturer Somona, Lyons), the Dutch Enkalon (manufacturer Algemene Kanstzijde-Arnhelm), the West German Perlon (manufacturer Vereinigte Glanzstoff Fabriken, Wuppertal), as well as the Japanese polyamide fibre (manufacturer Toyo Rayon) and the Italian Ortalion (manufacturer S.A.Bemberg). Besides these products, also other extra-light fabrics have been produced, from material with 10 den titre (monophile with number of ends 142 threads in warp and 120 threads in weft) as well as heavier fabrics such as silon filter cloths weighing 245 grams per sq. metre. The processing costs (i.e. the total costs of production minus the price of the material) have been cut down, on an average, to 2/3 of the cost of weaving on automatic shuttle looms. The quality of the fabric is very good indeed. The finishing plants and the consumers express the opinion that the quality of polyamide fabrics produced on jet looms is definitely superior to the quality of fabrics produced on

automatic shuttle looms. This holds true, in particular, of fabrics with high density from fine materials, e.g. of monophiles having 10,15 or 20 den titres.

2. The pneumatic jet looms have been tested so far to a substantially smaller extent. On looms of this type, fabrics have been made from staple yarns, in plain or twill weave, with a density of up to 34 threads in the warp while using all the current counts of yarn. The material in the weft has been tested within a range of numbers metric 17-65. On an average, compared to plants equipped with shuttle looms a 30 % increase in the productivity of labour has been obtained.

3. The manufacture of nonwoven fabrics by the knitting-through method and on the ARACHNE machines has a universal character. It permits to produce diverse knitted-through fabrics from various raw materials and their mixing for various uses, by a very short procese, embracing only a small part of the spinning operation, while weaving, including the entire preparation, has been replaced by the highly productive knitting-through process. An entire range of fabrics is being produced embracing not only thermal and soundinsulating materials and interlinings, but also home textiles, upholstery fabrics, decorative textiles and apparel fabrics. The processing costs (i.e. the costs of the production minus the price of the raw materials) are reduced to from one half to one third of the cost required for the manufacture of dassical fabrics, and in many instances it is feasible to introduce less expensive materials, such as viscose. Furthermore, capital expenditure required for building given production capacities is reduced to about one third of the expenditure required for the building of plants of the same capacity equipped with traditional machinery.

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